UT to Pembroke Creek Wetland and Stream Restoration Monitoring Report

EEP Project # 283
EEP Contract # 004475
Monitoring Year 05

Submitted to:

Ecosystem Enhancement PROGRAM

NCDENR-EEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

Data Collection: 2012
Construction Completed: February 2008
Submitted: January 2013

Monitoring Firm

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Raleigh, NC 27609
Phone: (919) 278-2514
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Project Contact: Adam Spiller
Email: adam.spiller@kci.com
KCI Project No: 16121788_MY05

Design Firm

EcoEngineering, A Division of the John R. McAdams Company Inc.
2905 Meridian Parkway
Durham, NC 27713

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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The North Carolina Ecosystem Enhancement Program (EEP) restored, enhanced, and preserved wetlands and restored a headwater wetland valley, which is analogous to a stream in this setting, at the UT Pembroke Site in Chowan County, North Carolina. The 59-acre site is located within the USGS 8-digit HUC 03010205 of the Pasquotank River Basin. These assets and their acreage totals were revised by the EEP during the summer of 2009, with the revised totals reflected in Table 1 of this report. The project goals and objectives are listed below.

Goal: Modify the channelized water features, based on reference conditions, with the intent to restore the site's primary wetland functions such as nutrient cycling, flood storage, and wildlife habitat.

Objectives:

- Improve water quality in the basin by filtering nutrients through on-site wetlands.
- Buffer flood flows downstream by increasing infiltration and storage areas.
- Design a waterway through the wetland complex with appropriate cross-section, slope, and pattern as to provide nutrient filtering, flood storage, and wildlife habitat while meeting the appropriate success criteria for the wetland.
- Improve terrestrial and aquatic habitat diversity.
- Establish a contiguous buffer along the project that can serve as a migration corridor for local fauna.

The restored wetlands and headwater wetland valley were planted with one of three different planting zones, each with various species of bare root trees and shrubs. Following the CVS-EEP protocol, sixteen vegetation monitoring plots were established during the baseline data collection immediately after the site was planted. Plot number 14 was damaged during road maintenance and was reset in the same location during the second year of monitoring. The fifth year of monitoring found a site average of 215 planted stems/acre, with nine of the sixteen vegetation monitoring plots having planted stem densities less than the five-year success criteria of 260 stems/acre. The site's average total stem density including volunteers is 1,495 stems/acre.

Volunteer trees that are sporadically present throughout the site are; black willow (*Salix nigra*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), and loblolly pine (*Pinus taeda*). The only exotic species identified at the site are parrotfeather (*Myriophyllum aquaticum*), which is present in areas of open standing water, honeysuckle (*Lonicera japonica*), which is scattered throughout the site, a few Chinaberry trees (*Melia azedarach*), and privet (*Ligustrum sinense*), which is predominantly found in the enhancement wetland and has been shown on the CCPV. Some parts of the site have large cattail (*Typha latifolia*) populations, which may out compete desirable vegetation and become problematic. There are also areas where the *Juncus effusus* is growing so vigorously that there are no planted stems in the surrounding area. Supplemental planting of the site was conducted in December of 2011. An open water area that is approximately 0.3 acres is located near vegetation plot 12, which results in a bare area of 0.9% of planted acreage for the site.

The restored headwater wetland valley is stable. In the parts of the site where there are large areas of standing water, the feature becomes less visually defined, but there is still active flow of water across the site. A maintenance plan was implemented in the fall of 2011 to enhance the movement or water through the headwater stream and prevent ponding along the existing farm road. This maintenance included adding a new road crossing and the removal of the top level of the drop down structure. For further details, please see the UT Pembroke Creek Wetland and Stream Restoration Site Repair Baseline Report (KCI, 2012).

Nineteen groundwater monitoring wells have been established to monitor wetland hydrology. Of these wells, five (4, 5, 6, 9, and 13) were installed in restored wetlands, two (2 and 3) were installed in enhanced wetlands, five (7, 8, 10, 11, and 15) were installed in the headwater wetland valley, and two (12 and 16) were installed in the preserved wetlands as reference wells. An additional monitoring well, Monitoring Well 17, was installed in the restored wetland in April 2009. In June 2010, four more monitoring wells, Monitoring Wells 18, 19, 20, and 21, were installed. During the site's fifth growing season, 12 of the 17 wells in the restoration and enhancement areas met the success criterion of having saturated soil conditions occurring within 12 inches of the ground surface for a minimum continuous period of 5% (13 days) of the 263 day growing season (March 10 to November 28) during average climatic conditions. The daily rainfall data obtained from a local weather station shows that the area had average rainfall during the 2012 growing season. The months of February, March, April, May, July, September, and October experienced average rainfall. Rainfall was less than average in January, June, and November, while August experienced above average rainfall.

The wells that did not meet the success criteria - Wells 5, 6, and 13 each had water above the jurisdictional depth for a maximum of ten consecutive days. Monitoring Well 5 experienced two gauge malfunctions which resulted in the gauges being replaced twice during the end of the growing season. Monitoring Wells 2 and 3 are in the enhanced wetland and Wells 5, 6, and 13 are in the restored non-riparian wetland. KCI is currently investigating the areas that are not meeting the hydrologic success.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on the EEP's website. All raw data supporting the tables and figures in the appendices are available from the EEP upon request.

2.0 METHODOLOGY

The Level 2 of the CVS-EEP protocol (http://cvs.bio.unc.edu/methods.htm) was used to collect vegetation data from the UT Pembroke site.

3.0 REFERENCES

Lee, M. T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm)

Weakley, A. S. 2006. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas. (http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2006-Jan.pdf)

KCI, 2012. UT Pembroke Creek Wetland and Stream Restoration Site Repair Baseline Report.

Appendix A

Project Vicinity Map and Background Tables

Directions to the Project Site:
From Raleigh, travel on US-64 E. Stay straight on US-17 N. Take exit 224 and take a left at the top of the ramp. Then take a left onto Emperor's Landing Rd. Then take a right onto Tip Toe Rd. Then take a right onto Macedonia Rd. The site will be on your right.

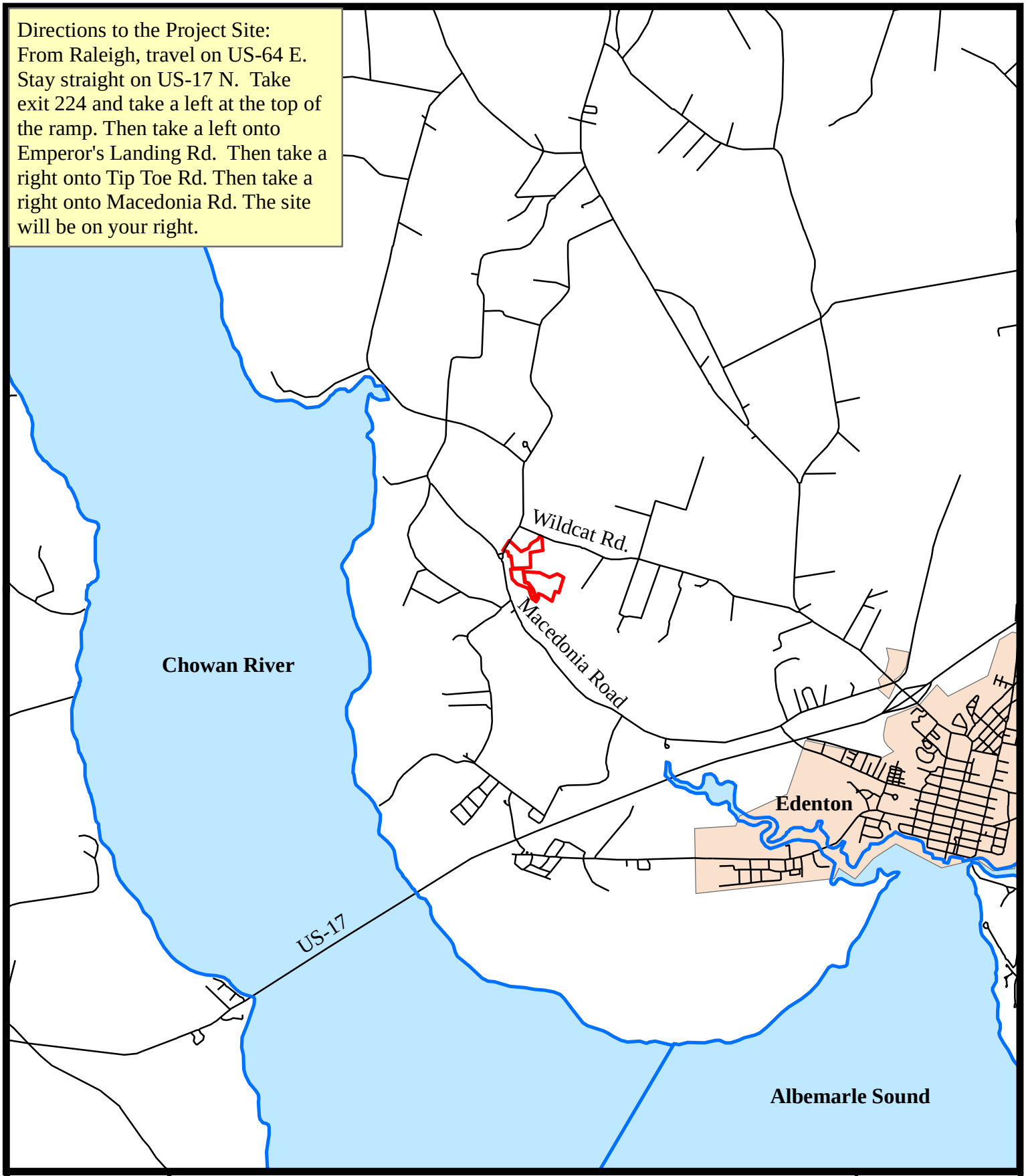


Figure 1. Site Vicinity Map
UT Pembroke Creek, Chowan County, EEP Project # 283

Project Easement Boundary

0.5 0.25 0 0.5 1 Miles

N W E S

Ecosystem Enhancement Program

KCI Associates of NC

Table 1a. Project Restoration Components
Project Number and Name: 283 - UT to Pembroke Creek

Segment/ Reach ID	Existing Linear Feet	Restoration Level	Approach	Linear Feet / Acreage	Stationing	Mitigation Ratio	Mitigation Units	BMP Elements	Comment
Headwater Wetland Valley	-	R	-	4,488 lf	00+00 to 34+73 and 40+00 to 58+72	1:1	4,488	-	This feature is 100 feet wide for its entire length, encompassing 9.96 acres.
Riparian Wetlands	-	R	-	13.81 ac	-	1:1	13.81	-	
Non-Riparian Wetlands	-	R	-	4.46 ac	-	1:1	4.46	-	
Non-Riparian Wetlands	-	E	-	5.26 ac	-	2:1	2.63	-	
Riparian Wooded Wetlands	-	P	-	8.95 ac	-	5:1	1.79	-	
Non-Riparian Wooded Wetlands	-	P	-	25.92 ac	-	5:1	5.18	-	

R = Restoration E = Enhancement P = Preservation

Table 1b. Project Component Summations
Project Number and Name: 283 - UT to Pembroke Creek

Restoration Level	Stream (lf)	Riparian Wetland (Ac)		Non-Ripar (Ac)	Upland (Ac)	Buffer (Ac)	BMP
		Riverine	Non-Riverine				
Restoration	4,488		13.81	4.46			
Enhancement				5.26			
Enhancement I							
Enhancement II							
Creation							
Preservation			8.95	25.92			
HQ Preservation							
		0	22.76				
Totals (Feet/Acres)	**4,488**	**22.76**		**35.64**	**0**		
MU Totals	**4,488**	**15.60**		**12.27**	**0**		

Table 2. Project Activity and Reporting History Project Number and Name: 283 - UT to Pembroke Creek		
Elapsed Time Since Grading Complete: 4 yr 10 months **Elapsed Time Since Planting Complete: 5 yr 0 months** **Number of Reporting Years: 5**		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	2006	Sep 06
Final Design - 90%		Mar 07
Construction		Feb 08
As-Built Survey		Nov 07
Bare-Root Planting		Dec 07
Baseline Monitoring (Mitigation Plan)		Oct 08
Year 1 Monitoring	Nov 08	Mar 09
Year 2 Monitoring	Nov 09	Dec 09
Year 3 Monitoring	Nov 10	Dec 10
Year 4 Monitoring	Nov 11	Dec 11
Site Maintenance and Supplemental Planting		Dec 11
Year 5 Monitoring	Aug 12	Dec 12

Table 3. Project Contacts Table Project Number and Name: 283 - UT Pembroke	
Design Firm	EcoEngineering, A Division of the John R. McAdams Company Inc. 2905 Meridian Parkway Durham, North Carolina 27713 Contact: Mr. James M. Halley, P.E. Phone: (919) 287-4262 Fax: (919) 361-2269
Construction Contractor	Backwater Environmental PO Box 1654 119 Ilex Court Pittsboro, North Carolina 27312 Contact: Mr. Adam McIntyre Phone: (919) 482-8491
Planting Contractor	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, North Carolina 27932 Phone: (252) 482-8491
Site Maintenance	
Design Firm	KCI Associates of NC Contact: Mr. Adam Spiller see below for additional contact information
Construction Contractor	Land Mechanics Designs 126 Circle G Lane Willow Springs, NC 27592 Contact: Mr. Lloyd Glover Phone: (919) 639-6132
Planting Contractor	Bruton Natural Systems PO Box 1197 Fremont, North Carolina 27830 Contact: Mr. Charlie Bruton Phone: (919) 242-6555
Monitoring Performers	
Mitigation Plan and MY-01	EcoEngineering, A Division of the John R. McAdams Company Inc. 2905 Meridian Parkway Durham, North Carolina 27713 Contact: Mr. James M. Halley, P.E. Phone: (919) 287-4262 Fax: (919) 361-2269
MY-02, 03, 04	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Attribute Table **Project Number and Name: 283 - UT Pembroke**	
Project County	Chowan County
Drainage Area	0.4 mi^2
Drainage Impervious Cover Estimate (%)	<5%
Physiographic Region	Outer Coastal Plain
Easement Acreage	59.4 ac
Planted Acreage	32.6 ac
Total Vegetated Acreage	59.4 ac
Ecoregion	Chesapeake-Pamlico Lowlands and Tidal Marshes
Plant Communities	Coastal Plain Small Stream Swamp, Nonriverine Wet Hardwood Forest, and Mesic Mixed Hardwood Forest
Dominant Soil Types	Cape Fear, Conetoe, Dragston, Portsmouth, Roanoke, and Tomotley
Reference Site ID	Reference Sites 1, 2, 3, and 4
USGS HUC for Project and References	03010205
Any portion of the project segment 303d listed?	No
Any portion of the project segment upstream of a 303d listed segment?	No
Reasons for 303d Listing or Stressor	N/A
% of Project Fenced	0%

Appendix B

Visual Assessment Data

PROJECT CONDITION

VEG PLOT ACHIEVING DENSITY CRITERION

VEG PLOT BELOW DENSITY CRITERION

WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION

WETLAND GAUGE BELOW HYDROLOGIC CRITERION

INVASIVE SPECIES (PRIVET)

LEGEND

EASEMENT BOUNDARY

AS-BUILT STATIONED CENTERLINE 12+00 13+00

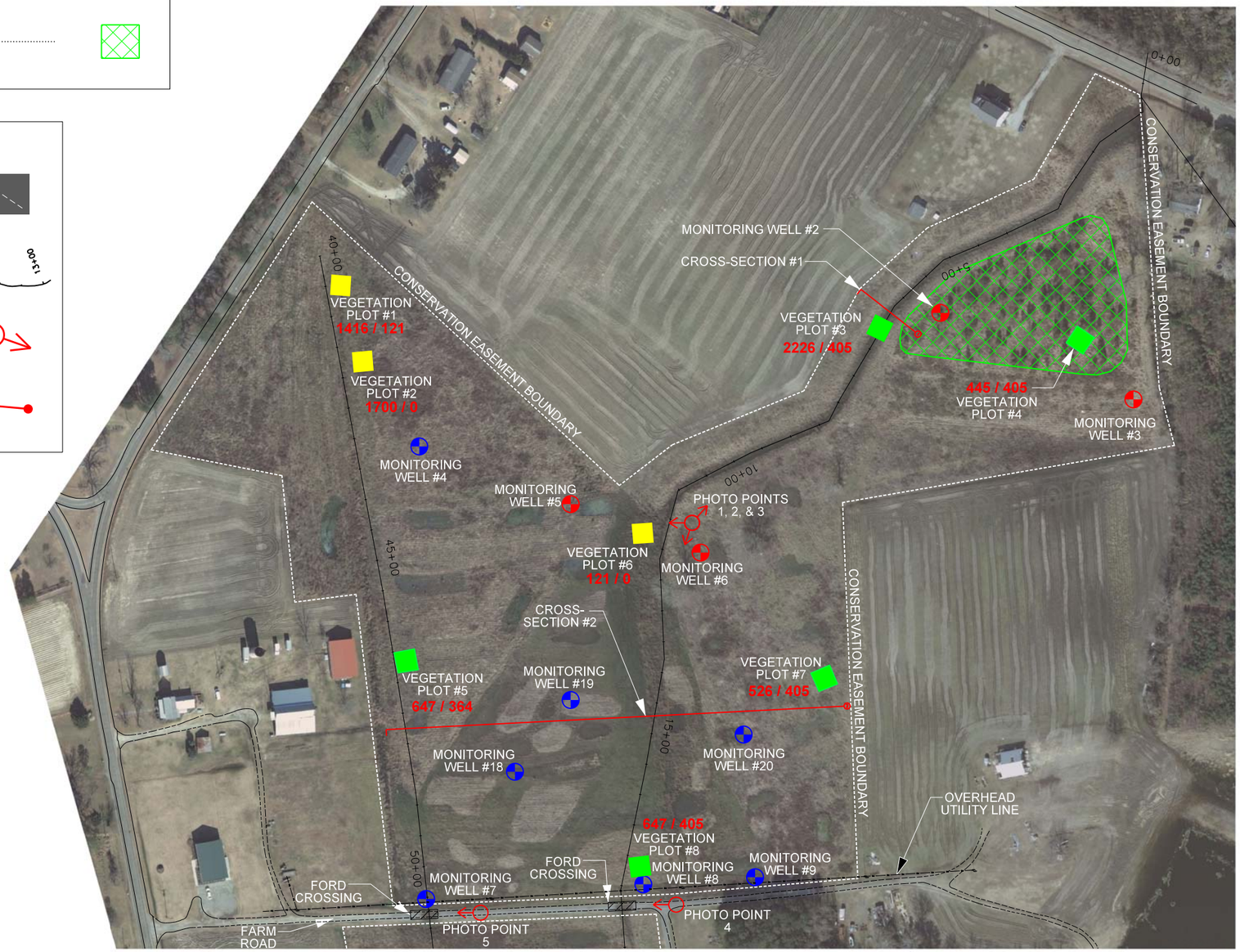
PHOTO POINT

CROSS-SECTION

PROJECT CONDITION DETAILS

VEG PLOT TOTAL / PLANTED STEM DENSITY ..... 1495 / 215

IMAGE SOURCE: NC 2010 ORTHOIMAGERY



MATCHLINE - SEE SHEET 2

MATCHLINE - SEE SHEET 2

NC GRID NAD 83

–100 –50 0 100 200

GRAPHIC SCALE

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

UT PEMBROKE CREEK WETLAND AND STREAM RESTORATION

EEP PROJECT #283

CHOWAN COUNTY, NORTH CAROLINA

UT PEMBROKE, MONITORING YEAR 05

DATE: NOV 2012

SCALE: 1" = 200'

CURRENT CONDITION PLAN VIEW

SHEET 1 OF 2

LEGEND

EASEMENT BOUNDARY .....

AS-BUILT STATIONED CENTERLINE ..... 12+00 13+00

PHOTO POINT .....

CROSS-SECTION .....

PROJECT CONDITION

VEG PLOT ACHIEVING DENSITY CRITERION .....

VEG PLOT BELOW DENSITY CRITERION .....

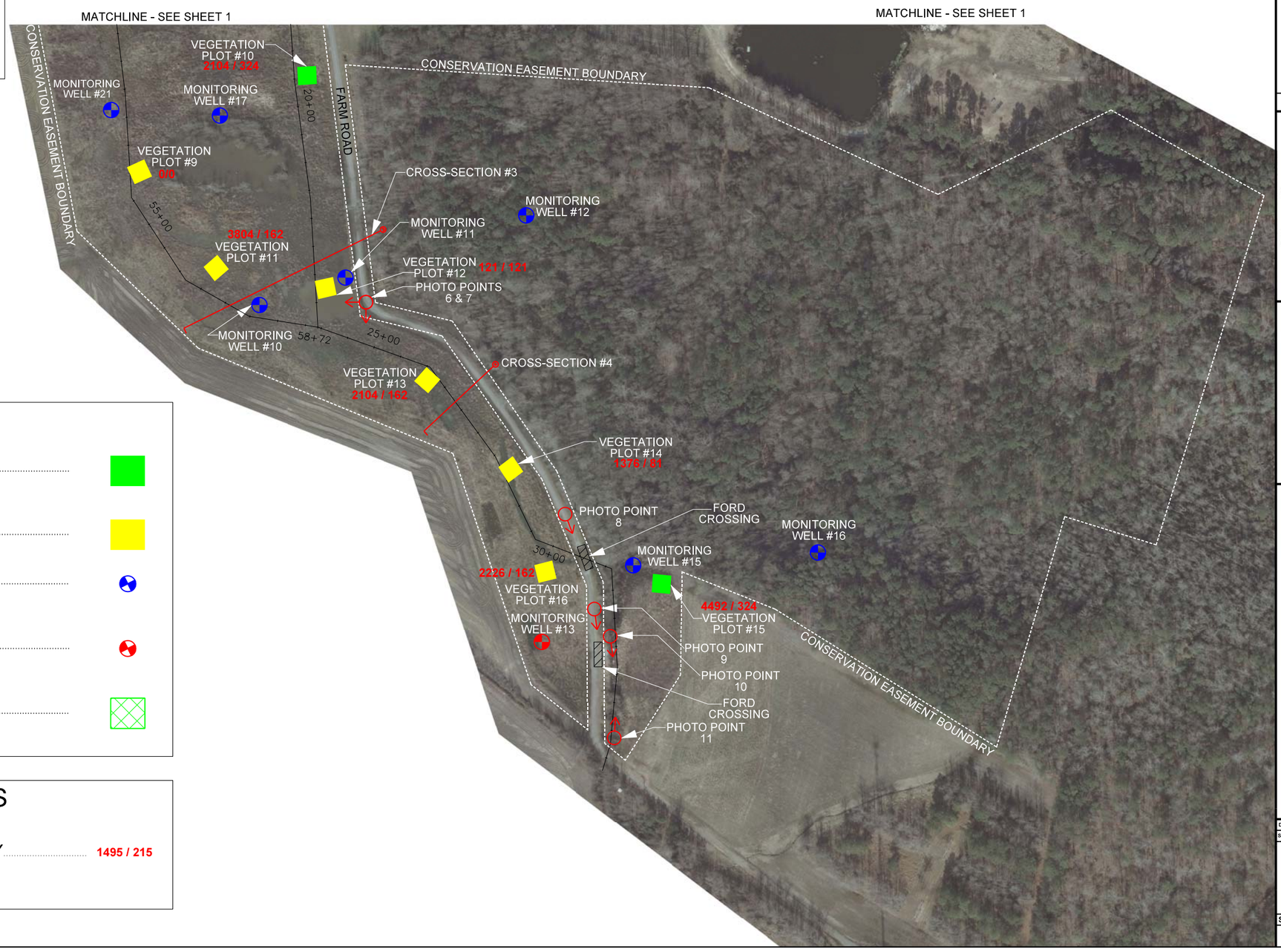
WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION .....

WETLAND GAUGE BELOW HYDROLOGIC CRITERION .....

INVASIVE SPECIES (PRIVET) .....

PROJECT CONDITION DETAILS

VEG PLOT TOTAL / PLANTED STEM DENSITY ..... 1495 / 215



REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

UT PEMBROKE CREEK
WETLAND AND STREAM RESTORATION
EEP PROJECT #283
CHOWAN COUNTY, NORTH CAROLINA
UT PEMBROKE, MONITORING YEAR 05

DATE: NOV 2012
SCALE: 1" = 200'

CURRENT CONDITION PLAN VIEW

Table 5. Vegetation Condition Assessment

Project Number and Name: 283 - UT to Pembroke Creek Wetland and Stream

Planted Acreage 32.6 **Easement Acreage 59.4**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	1	0.30	0.9%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Not Depicted, Covers Most of Restoration Area	0	0.00	0.0%
			Total	1	0.30	0.9%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	1	0.30	0.9%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	1	1.40	2.4%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

Photo Point Photos

Photo Point 1 – 12/2/09 - MY 02 – Facing northwest toward Wildcat Road.


Photo Point 1 – 10/30/12 - MY 05 – Facing northwest toward Wildcat Road.

Photo Point 2 – 12/2/09 - MY 02 – Facing west toward Macedonia Road.


Photo Point 2 – 10/30/12 - MY 05 – Facing west toward Macedonia Road.

Photo Point 3 – 12/2/09 - MY 02 – Facing south toward the downstream end of the project.


Photo Point 3 – 10/30/12 - MY 05 – Facing south toward the downstream end of the project.

Photo Point 4 – 12/2/09 - MY 02 – Road Crossing Type A – Station 17+75 – Facing west toward Macedonia Road.

Photo Point 4 – 10/30/12 - MY 05 – Road Crossing Type A – Station 17+75 – Facing west toward Macedonia Road.

Photo Point 5 – 12/2/09 - MY 02 – Road Crossing Type A – Station 50+75 – Facing west toward Macedonia Road.

Photo Point 5 – 10/30/12 - MY 05 – Road Crossing Type A – Station 50+75 – Facing west toward Macedonia Road.

Photo Point 6 – 12/2/09 - MY 02 –Facing northwest toward Macedonia Road.

Photo Point 6 – 10/30/12 - MY 05 –Facing northwest toward Macedonia Road.

Photo Point 7 – 12/2/09 - MY 02– Facing south.


Photo Point 7 – 10/30/12 - MY 05 - MY 04 – Facing south.

Photo Point 8 – 12/2/09 - MY 02 – Road Crossing Type B – Station 30+50


Photo Point 8 – 10/30/12 - MY 05 – Road Crossing Type B – Station 30+50

Photo Point 9- 12/2/09 - MY 02 – Road Crossing Type C – Station 32+50


Photo Point 9 – 10/30/12 - MY 05 – Road Crossing Type C – Station 32+50

Photo Point 10 – 12/2/09 - MY 02 – Grade transition, facing downstream.


Photo Point 10/30/12 - MY 05 – Grade transition, facing downstream.

Photo Point 11 12/2/09 - MY 02 – Grade transition, facing upstream


Photo Point 11 – 10/19/11 - MY 04 – Grade transition, facing upstream.

Vegetation Monitoring Plot Photos

Plot 1 – 8/13/12 - MY 05 - Facing Macedonia Road on the northwestern portion of the site

Plot 2 – 11/28/12 - MY 05 - Facing Macedonia Road on the northwestern portion of the site

Plot 3 – 8/13/12 - MY 05 - Facing intersection of Macedonia Road and Wildcat Road

Plot 4 – 8/13/12 - MY 05 - Facing Macedonia Road and Wildcat Road on the northeastern portion of the site

Plot 5 – 8/13/12 - MY 05 - Facing Macedonia Road on western portion of the site

Plot 6 – 11/28/12 - MY 05 - Facing Macedonia Road on the central portion of the site

Plot 7 – 8/13/12 - MY 05 - Facing intersection of Macedonia Road on the western portion of the site

Plot 8 – 8/13/12 - MY 05 - Facing Macedonia Road on central portion of the site just north of the main road

Plot 9 – 8/13/12 - MY 05 - Facing Macedonia Road on western portion of the site near the pond

Plot 10 – 8/13/12 - MY 05 - Facing Macedonia Road just southwest of the intersection of the main road and the dirt access road

Plot 11 – 8/13/12 - MY 05 - Facing Macedonia Road just south of Plot 9 near the pond

Plot 12 – 8/13/12 - MY 05 - Facing Macedonia Road just south of the pond

Plot 13 – 11/28/12 - MY 05 - Facing Macedonia Road on southwestern portion of the site

Plot 14 – 8/13/12 - MY 05 - Facing Macedonia Road on southwestern portion of the site

Plot 15 – 8/13/12 - MY 05 - Facing east on the southeastern portion of the site

Plot 16 – 8/13/12 - MY 05 - Facing Macedonia Road on the southwestern portion of the site

Appendix C

Vegetation Plot Data

Table 6. Vegetation Plot Mitigation Success Summary Table Project Number and Name: 283 - UT Pembroke			
Vegetation Plot ID	**Monitoring Year 05 Planted Stem Density (260 stems/acre)**	**Vegetation Survival Threshold Met?**	**Monitoring Year 05 Total Stem Density (stems/acre)**
1	121	No	1,416
2	0	No	1,700
3	405	Yes	2,226
4	405	Yes	445
5	364	Yes	647
6	0	No	121
7	405	Yes	526
8	405	Yes	647
9	0	No	0
10	324	Yes	2,104
11	162	No	3,804
12	121	No	121
13	162	No	2,104
14	81	No	1,376
15	324	Yes	4,492
16	162	No	2,226

Table 7. CVS Vegetation Plot Metadata Project Number and Name: 283 - UT Pembroke	
Report Prepared By	April Helms
Date Prepared	10/30/2012 9:11
database name	KCI-2012-A.mdb
database location	M:\2007\12071067_2007 EEP OPEN END\Veg_database
computer name	12-CV76KF1
file size	59768832
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	283
project Name	UT Pembroke
Description	Stream and wetland restoration site in Chowan County, NC
River Basin	Roanoke
length(ft)	4,488
stream-to-edge width (ft)	50
area (sq m)	41,691
Required Plots (calculated)	11
Sampled Plots	16

Table 8. Stem Count Total and Planted by Plot and Species
Project Number and Name: 283 - UT Pembroke

			Current Plot Data (MY5 2012)																						
			E283-01-0001			E283-01-0002			E283-01-0003			E283-01-0004			E283-01-0005			E283-01-0006			E283-01-0007			E283-01-0008		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree									18									2						4
Baccharis	baccharis	Shrub						2																		
Carya	hickory	Tree															1						1			
Diospyros virginiana	common persimmon	Tree																								
Fraxinus pennsylvanica	green ash	Tree																								
Itea virginica	Virginia sweetspire	Shrub																								
Juglans nigra	black walnut	Tree																					1			
Juniperus virginiana	Eastern red cedar	Tree						2																		
Ligustrum sinense	Chinese privet	Exotic																								
Liquidambar styraciflua	sweetgum	Tree			32			16			4			1			4						1			
Liriodendron tulipifera	tuliptree	Tree	1	1	1				3	3	3	7	7	7	3	3	3				4	4	4			
Morella cerifera	wax myrtle	shrub							4	4	8													1	1	1
Morus	mulberry	Tree															2									
Nyssa biflora	swamp tupelo	Tree							1	1	1													7	7	7
Persea palustris	swamp bay	tree																								
Pinus taeda	loblolly pine	Tree						22																		
Platanus occidentalis	American sycamore	Tree									19															
Populus deltoides	eastern cottonwood	Tree																								
Prunus serotina	black cherry	Tree																								
Pyrus calleryana	Callery pear	Exotic																								
Quercus	oak	Tree																								1
Quercus alba	white oak	Tree	1	1	1																					
Quercus falcata	southern red oak	Tree																								
Quercus laurifolia	laurel oak	Tree													1	1	1							1	1	1
Quercus lyrata	overcup oak	Tree																								
Quercus michauxii	swamp chestnut oak	Tree							1	1	1										2	2	2			1
Quercus nigra	water oak	Tree	1	1	1				1	1	1	2	2	2	1	1	1							1	1	1
Quercus phellos	willow oak	Tree										1	1	1												
Rhus	sumac	shrub																								
Rhus copallinum	flameleaf sumac	shrub																								
Salix nigra	black willow	Tree																		1						
Salix sericea	silky willow	Shrub																								
Sambucus canadensis	Common Elderberry	Shrub													1	1	1				3	3	3			
Sambucus nigra	European black elderberry	Shrub																								
Taxodium distichum	bald cypress	Tree																								
Ulmus americana	American elm	Tree													3	3	3				1	1	1			
	Stem count		3	3	35	0	0	42	10	10	55	10	10	11	9	9	16	0	0	3	10	10	13	10	10	16
	size (ares)		1			1			1			1			1			1			1			1		
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
	Species count		3	3	4	0	0	4	5	5	8	3	3	4	5	5	8	0	0	2	4	4	7	4	4	7
	Stems per ACRE		121	121	1416	0	0	1700	405	405	2226	405	405	445	364	364	647	0	0	121	405	405	526	405	405	647

Table 8. Stem Count Total and Planted by Plot and Species continued
Project Number and Name: 283 - UT Pembroke

			Current Plot Data (MY5 2012)																					
			E283-01-0009			E283-01-0010			E283-01-0011			E283-01-0012			E283-01-0013			E283-01-0014			E283-01-0015			E283-01-0016		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree						7									6			2						
Baccharis	baccharis	Shrub															1						4			5
Carya	hickory	Tree																								
Diospyros virginiana	common persimmon	Tree																								
Fraxinus pennsylvanica	green ash	Tree													1	1	1									
Itea virginica	Virginia sweetspire	Shrub																								
Juglans nigra	black walnut	Tree																								
Juniperus virginiana	Eastern red cedar	Tree																								
Ligustrum sinense	Chinese privet	Exotic																								
Liquidambar styraciflua	sweetgum	Tree						2			1									11			72			11
Liriodendron tulipifera	tuliptree	Tree																						1	1	1
Morella cerifera	wax myrtle	shrub				3	3	3	1	1	1						16			3			7			3
Morus	mulberry	Tree																								
Nyssa biflora	swamp tupelo	Tree				3	3	3																		
Persea palustris	swamp bay	tree																						1	1	1
Pinus taeda	loblolly pine	Tree									3												11			
Platanus occidentalis	American sycamore	Tree																		8			3			11
Populus deltoides	eastern cottonwood	Tree															2									
Prunus serotina	black cherry	Tree																								
Pyrus calleryana	Callery pear	Exotic																								
Quercus	oak	Tree						2			2									1						
Quercus alba	white oak	Tree																			3	3	4			
Quercus falcata	southern red oak	Tree																								
Quercus laurifolia	laurel oak	Tree																								
Quercus lyrata	overcup oak	Tree																2	2	2				2	2	2
Quercus michauxii	swamp chestnut oak	Tree																			3	3	3			
Quercus nigra	water oak	Tree							1	1	1										1	1	1			
Quercus phellos	willow oak	Tree																								
Rhus	sumac	shrub																								
Rhus copallinum	flameleaf sumac	shrub																								
Salix nigra	black willow	Tree						33			84						23			7			5			21
Salix sericea	silky willow	Shrub																								
Sambucus canadensis	Common Elderberry	Shrub																								
Sambucus nigra	European black elderberry	Shrub																								
Taxodium distichum	bald cypress	Tree										3	3	3	2	2	2									
Ulmus americana	American elm	Tree				2	2	2	2	2	2				1	1	1				1	1	1			
	Stem count		0	0	0	8	8	52	4	4	94	3	3	3	4	4	52	2	2	34	8	8	111	4	4	55
	size (ares)		1			1			1			1			1			1			1			1		
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
	Species count		0	0	0	3	3	7	3	3	7	1	1	1	3	3	8	1	1	7	4	4	10	3	3	8
	Stems per ACRE		0	0	0	324	324	2104	162	162	3804	121	121	121	162	162	2104	81	81	1376	324	324	4492	162	162	2226

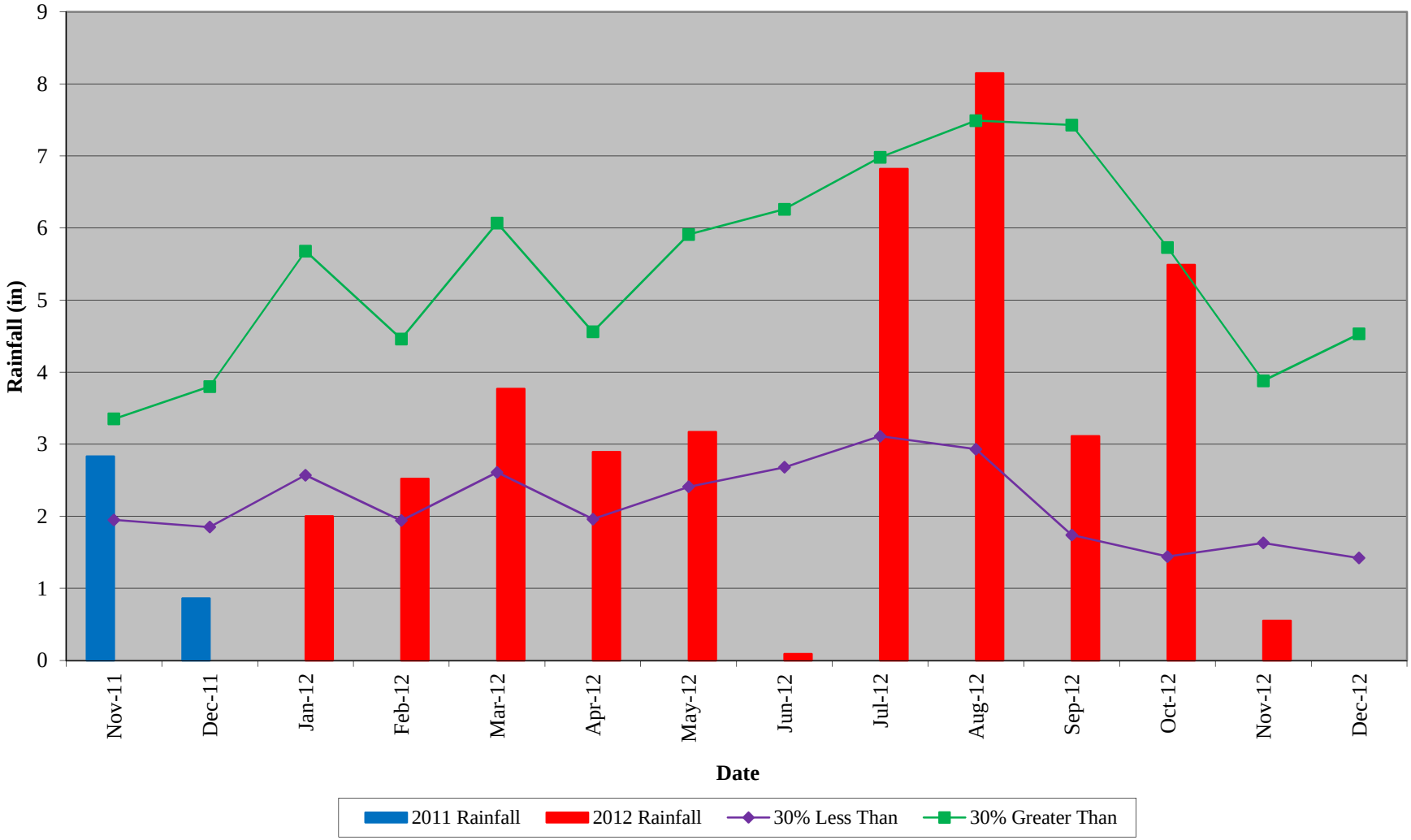
Table 8. Stem Count Total and Planted by Plot and Species continued
Project Number and Name: 283 - UT Pembroke

			Annual Means																	
			MY5 (2012)			MY4 (2011)			MY3 (2010)			MY2 (2009)			MY1 (2008)			MY0 (2008)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree			39			21			18			31						
Baccharis	baccharis	Shrub			12			7			9			6						
Carya	hickory	Tree			2						1									
Diospyros virginiana	common persimmon	Tree												5						
Fraxinus pennsylvanica	green ash	Tree	1	1	1						1									
Itea virginica	Virginia sweetspire	Shrub																5	5	5
Juglans nigra	black walnut	Tree			1			4			2			3						
Juniperus virginiana	Eastern red cedar	Tree			2															
Ligustrum sinense	Chinese privet	Exotic												1						
Liquidambar styraciflua	sweetgum	Tree			155			177			148			178						
Liriodendron tulipifera	tuliptree	Tree	19	19	19	19	19	19	19	19	19	21	21	24	16	16	16	36	36	36
Morella cerifera	wax myrtle	shrub	9	9	42	9	9	22	9	9	13	9	9	11	11	11	11	17	17	17
Morus	mulberry	Tree			2															
Nyssa biflora	swamp tupelo	Tree	11	11	11	11	11	11	11	11	11	14	14	14	16	16	16	34	34	34
Persea palustris	swamp bay	tree	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	7	7	7
Pinus taeda	loblolly pine	Tree			36									2						
Platanus occidentalis	American sycamore	Tree			41			36	1	1	30	1	1	6						
Populus deltoides	eastern cottonwood	Tree			2									1						
Prunus serotina	black cherry	Tree												3						
Pyrus calleryana	Callery pear	Exotic												1						
Quercus	oak	Tree			6			5			2									
Quercus alba	white oak	Tree	4	4	5	3	3	4	4	4	5	4	4	4	2	2	2	4	4	4
Quercus falcata	southern red oak	Tree										1	1	1						
Quercus laurifolia	laurel oak	Tree	2	2	2	2	2	2	2	2	2	2	2	2	6	6	6	34	34	34
Quercus lyrata	overcup oak	Tree	4	4	4	4	4	4	4	4	5	4	4	4	3	3	3	6	6	6
Quercus michauxii	swamp chestnut oak	Tree	6	6	7	8	8	8	8	8	8	10	10	10	13	13	13	19	19	19
Quercus nigra	water oak	Tree	8	8	8	8	8	8	8	8	8	10	10	10	8	8	8	23	23	23
Quercus phellos	willow oak	Tree	1	1	1	1	1	120	1	1	91	1	1	1						
Rhus	sumac	shrub						4			6									
Rhus copallinum	flameleaf sumac	shrub												12						
Salix nigra	black willow	Tree			174									63						
Salix sericea	silky willow	Shrub												56						
Sambucus canadensis	Common Elderberry	Shrub	4	4	4	6	6	6	6	6	6	6	6	6						
Sambucus nigra	European black elderberry	Shrub													7	7	7	9	9	9
Taxodium distichum	bald cypress	Tree	5	5	5									1						
Ulmus americana	American elm	Tree	10	10	9	10	10	11	10	10	10	11	11	11	15	15	15	31	31	31
		Stem count	85	85	591	82	82	470	84	84	396	95	95	468	100	100	100	225	225	225
		size (ares)	16			16			16			16			16			16		
		size (ACRES)	0.40			0.40			0.40			0.40			0.40			0.40		
		Species count	14	14	26	12	12	19	13	13	21	14	14	28	11	11	11	12	12	12
		Stems per ACRE	215	215	1495	207	207	1189	212	212	1002	240	240	1184	253	253	253	569	569	569

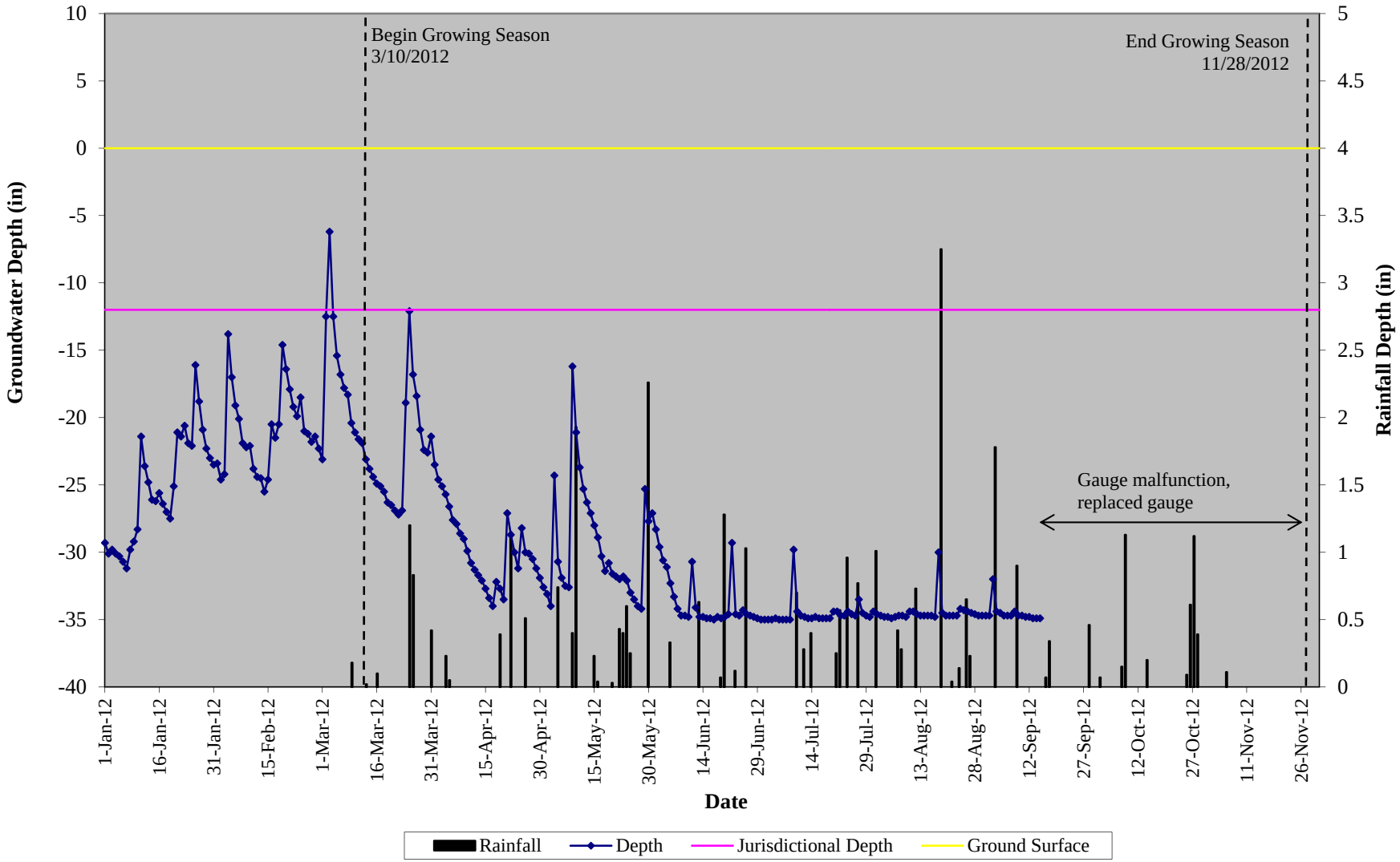
Appendix D

Hydrologic Data

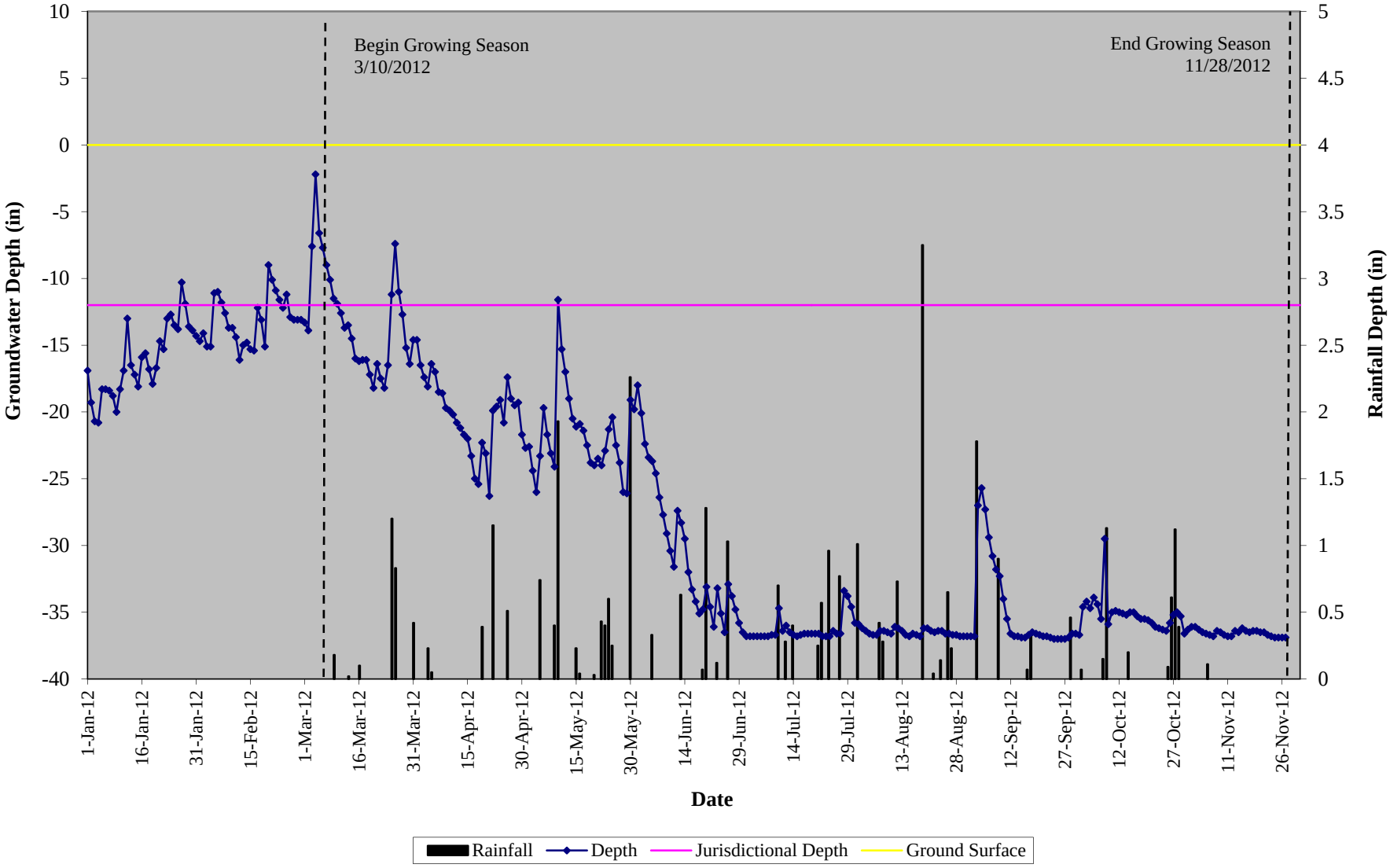
UT Pembroke 30-70 Percentile Graph 2011-2012
Edenton, NC Monthly Rainfall



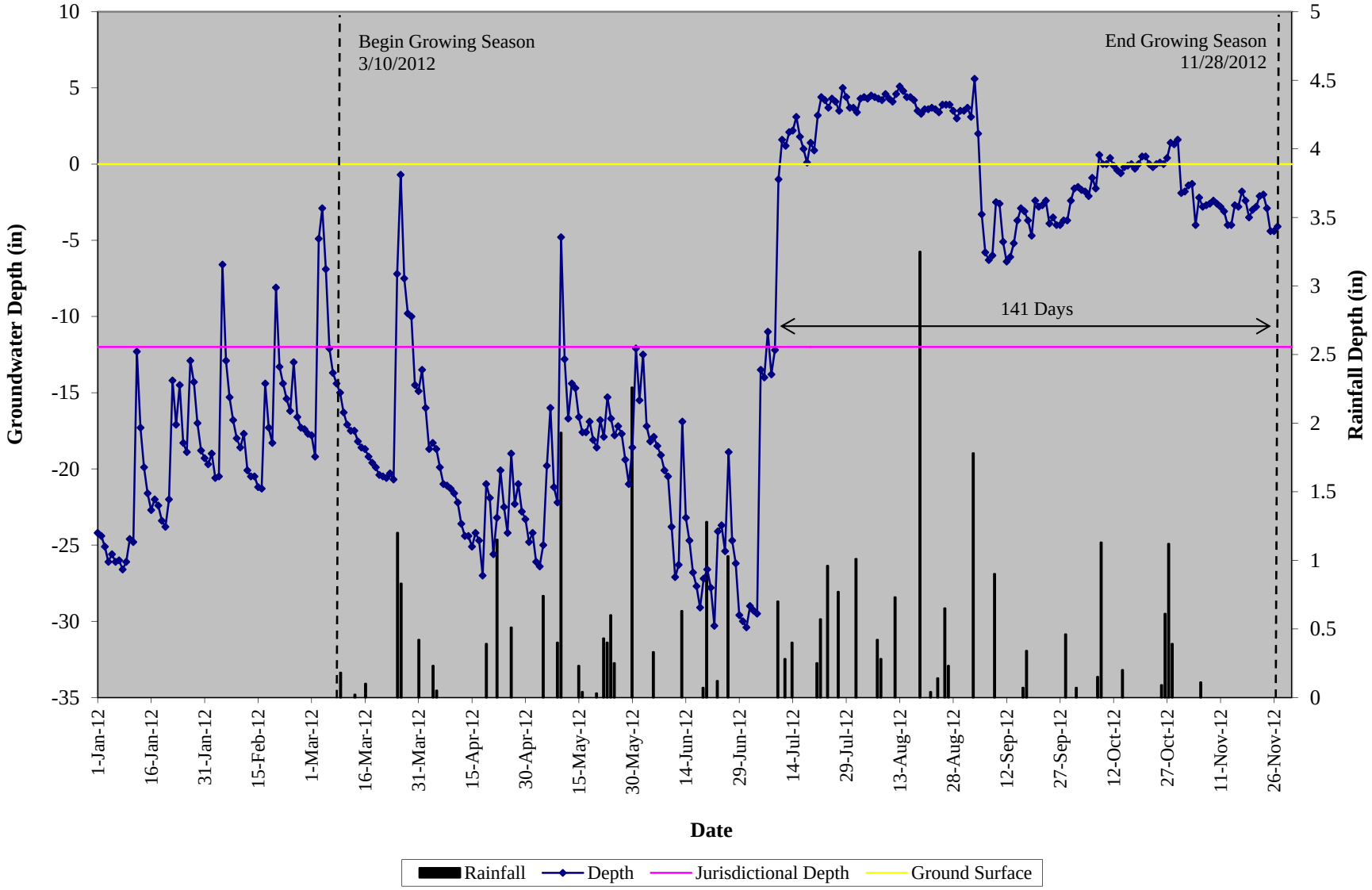
UT Pembroke MY05
Groundwater Monitoring Well #2



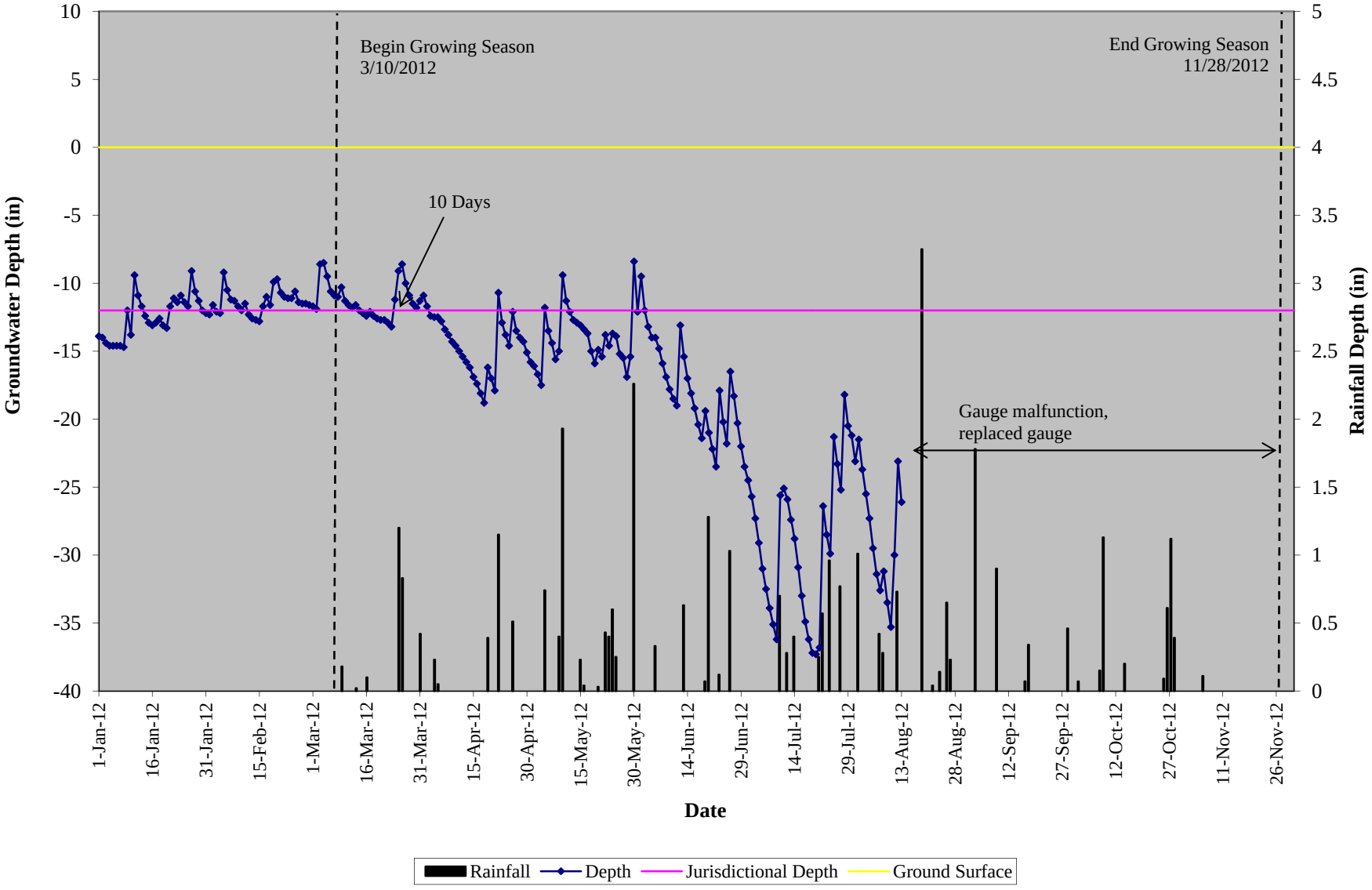
UT Pembroke MY05
Groundwater Monitoring Well #3



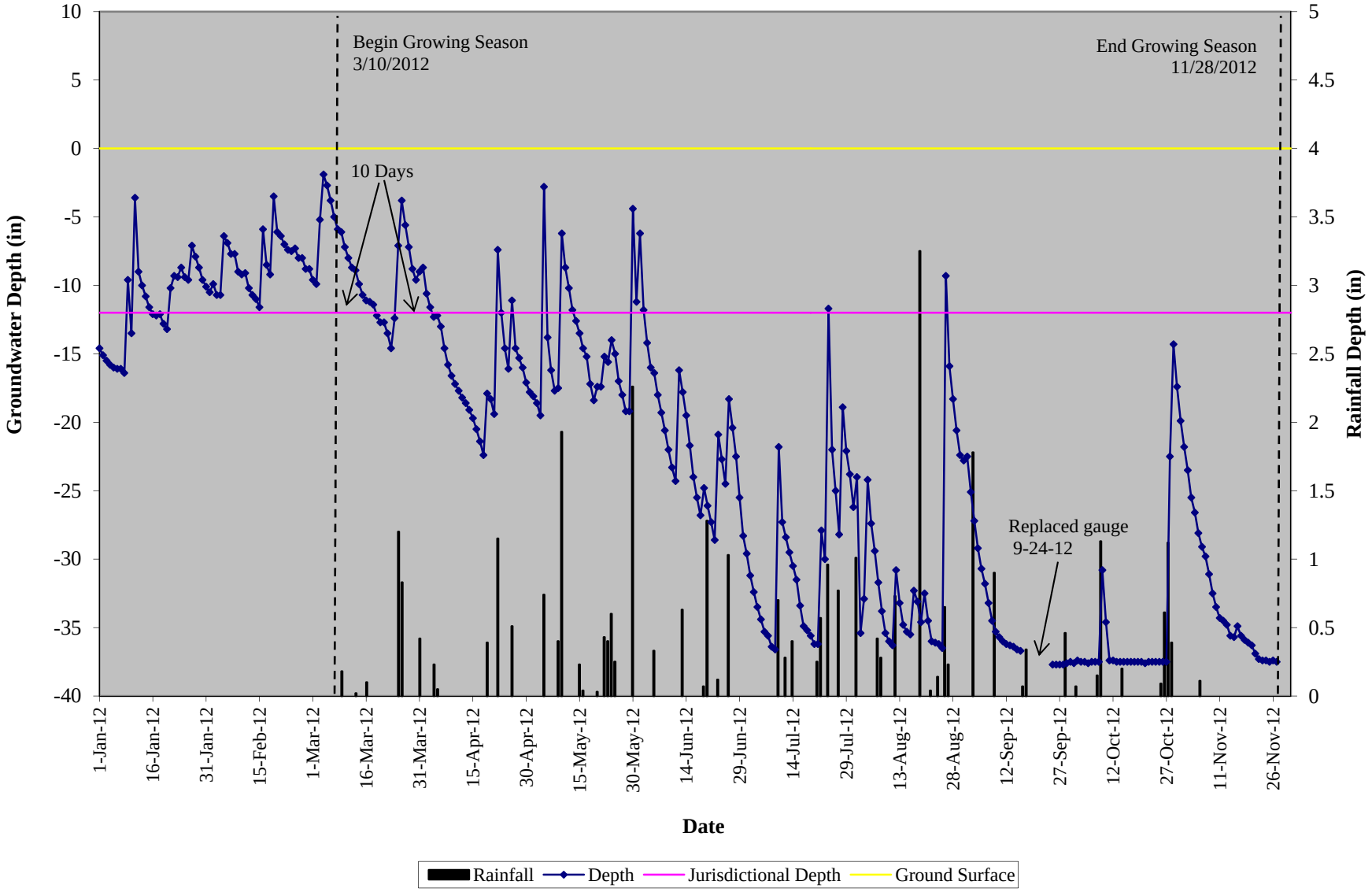
UT Pembroke MY05
Groundwater Monitoring Well #4



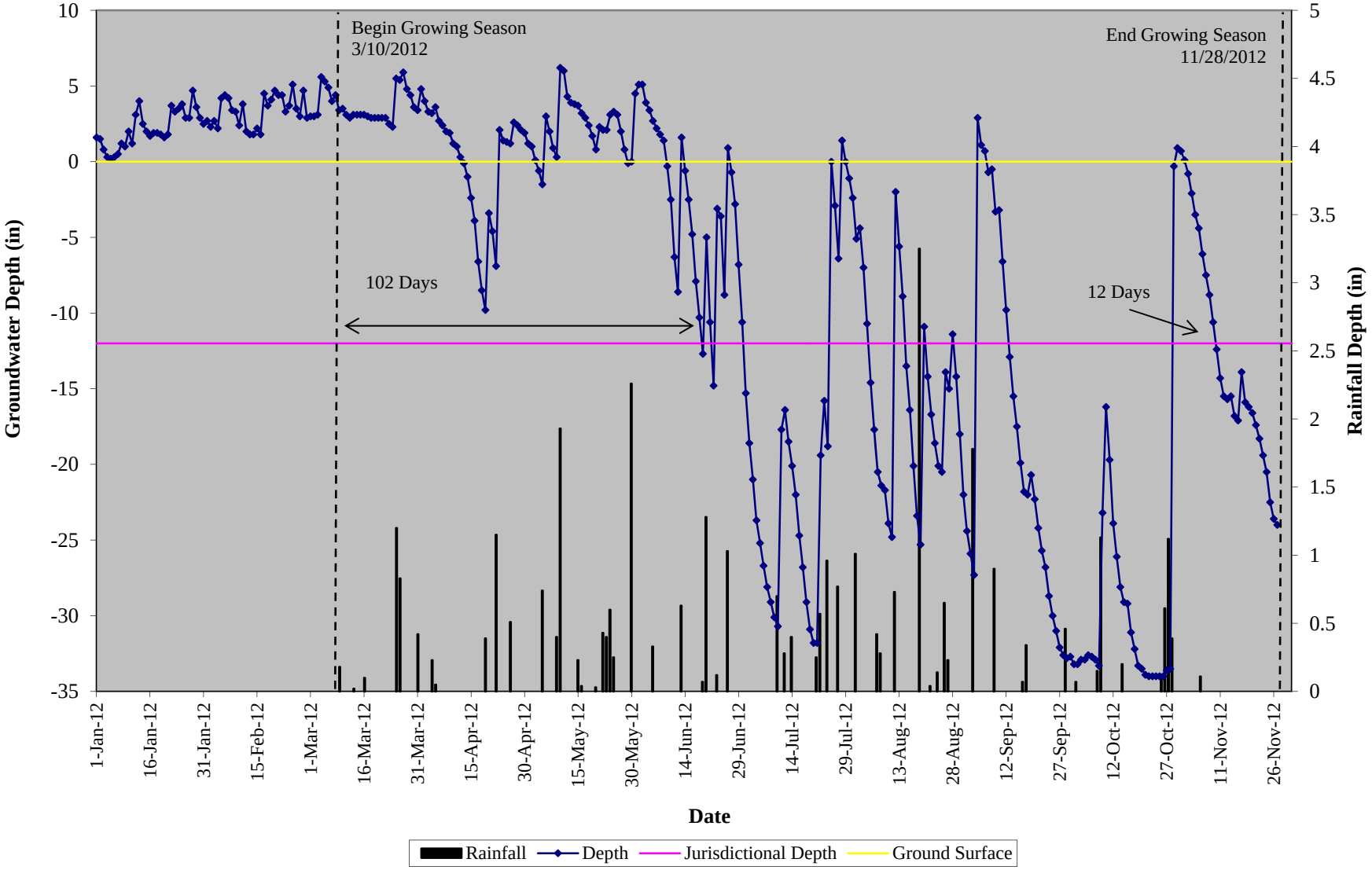
UT Pembroke MY05
Groundwater Monitoring Well #5



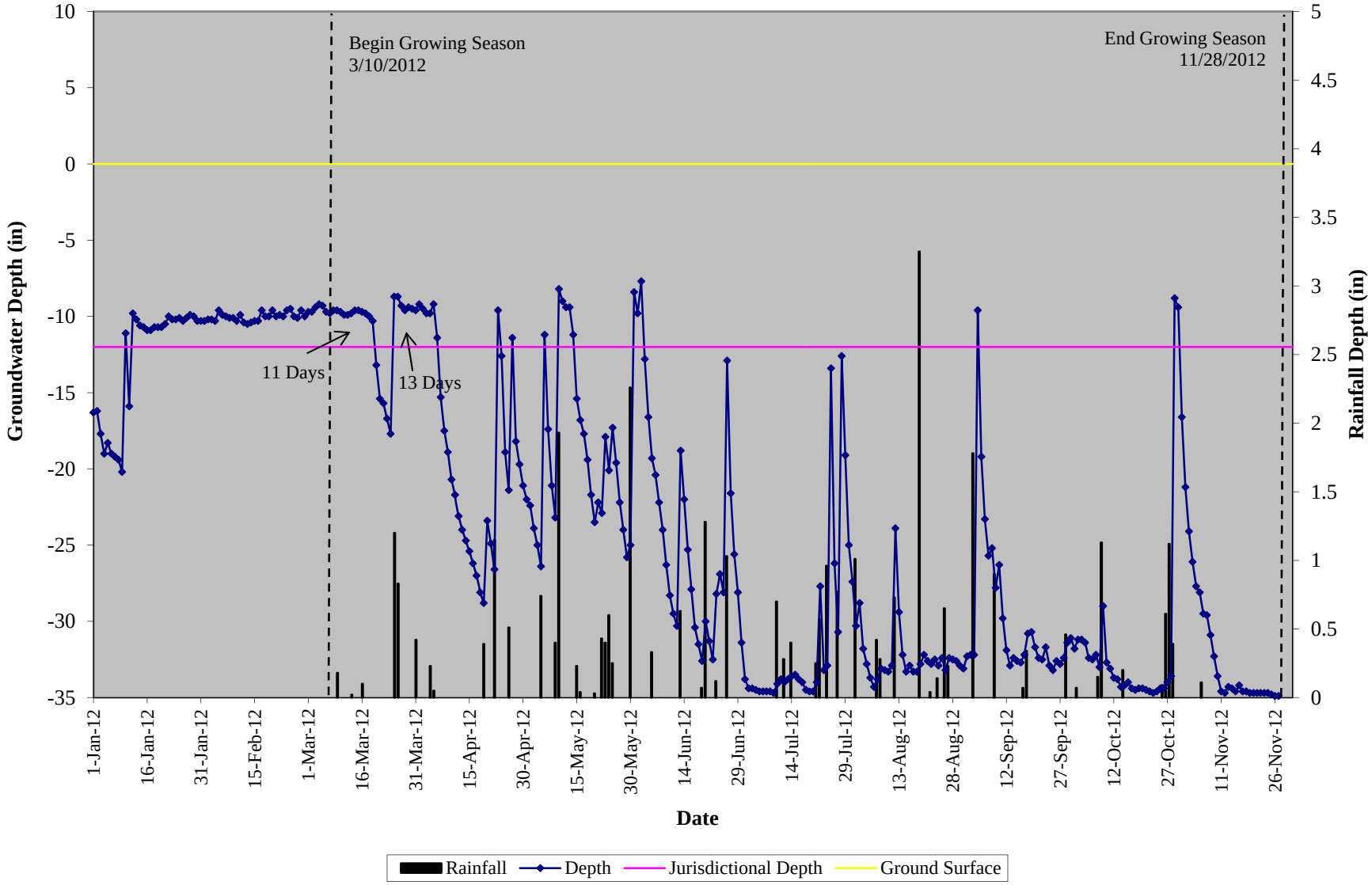
UT Pembroke MY05
Groundwater Monitoring Well #6



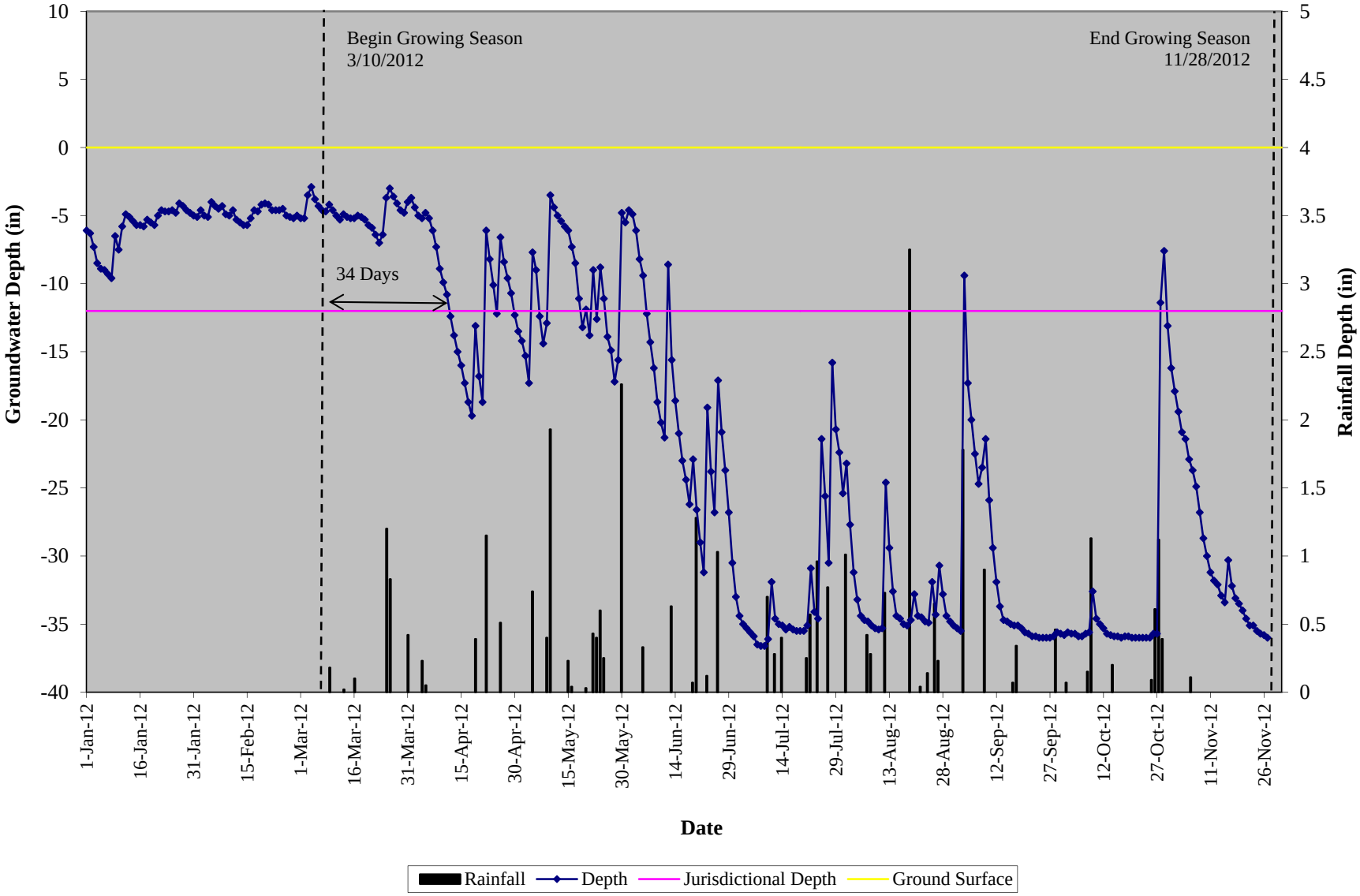
UT Pembroke MY05
Groundwater Monitoring Well #7



UT Pembroke MY05
Groundwater Monitoring Well #8



UT Pembroke MY05
Groundwater Monitoring Well #9



UT Pembroke MY05
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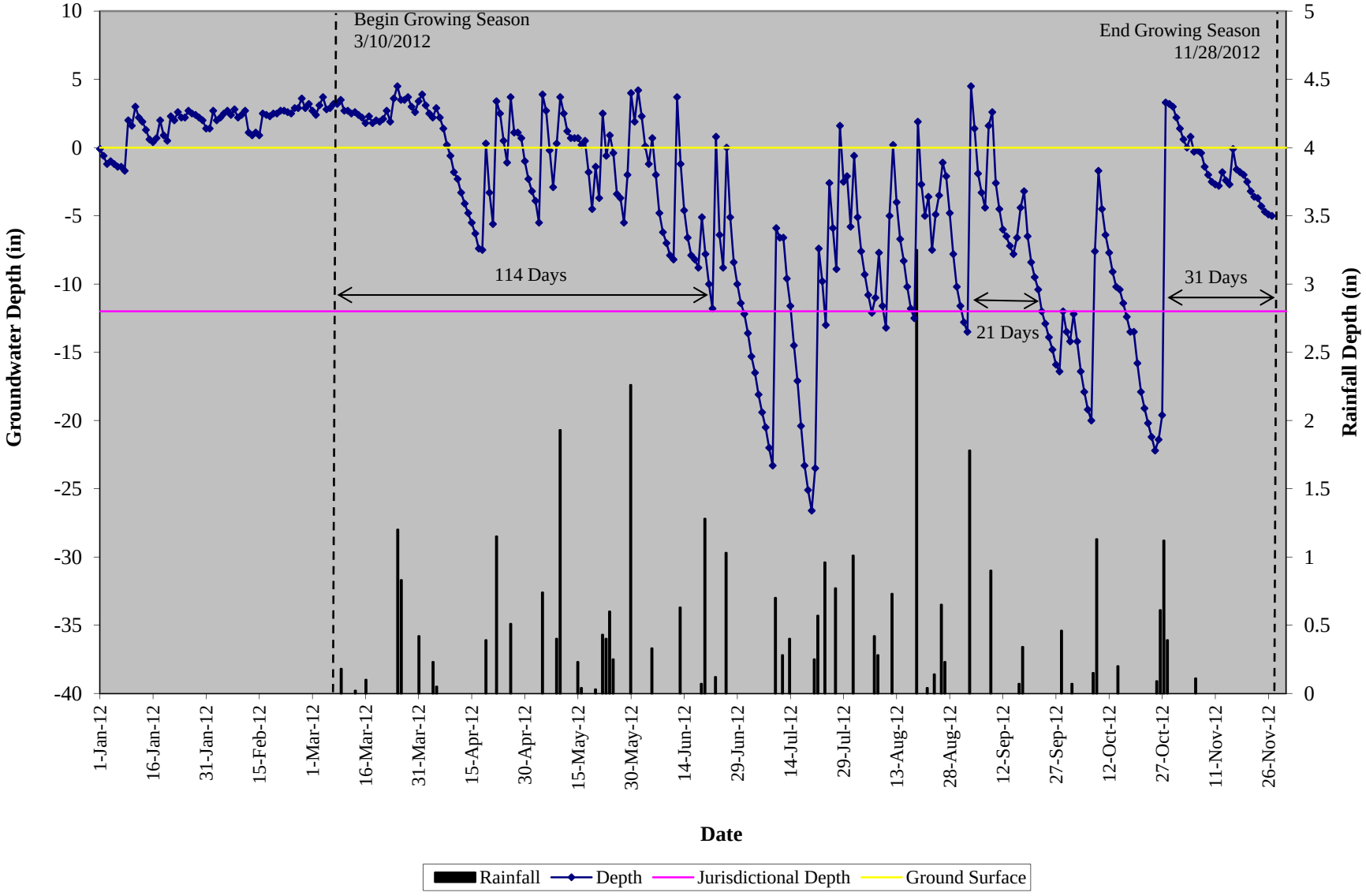
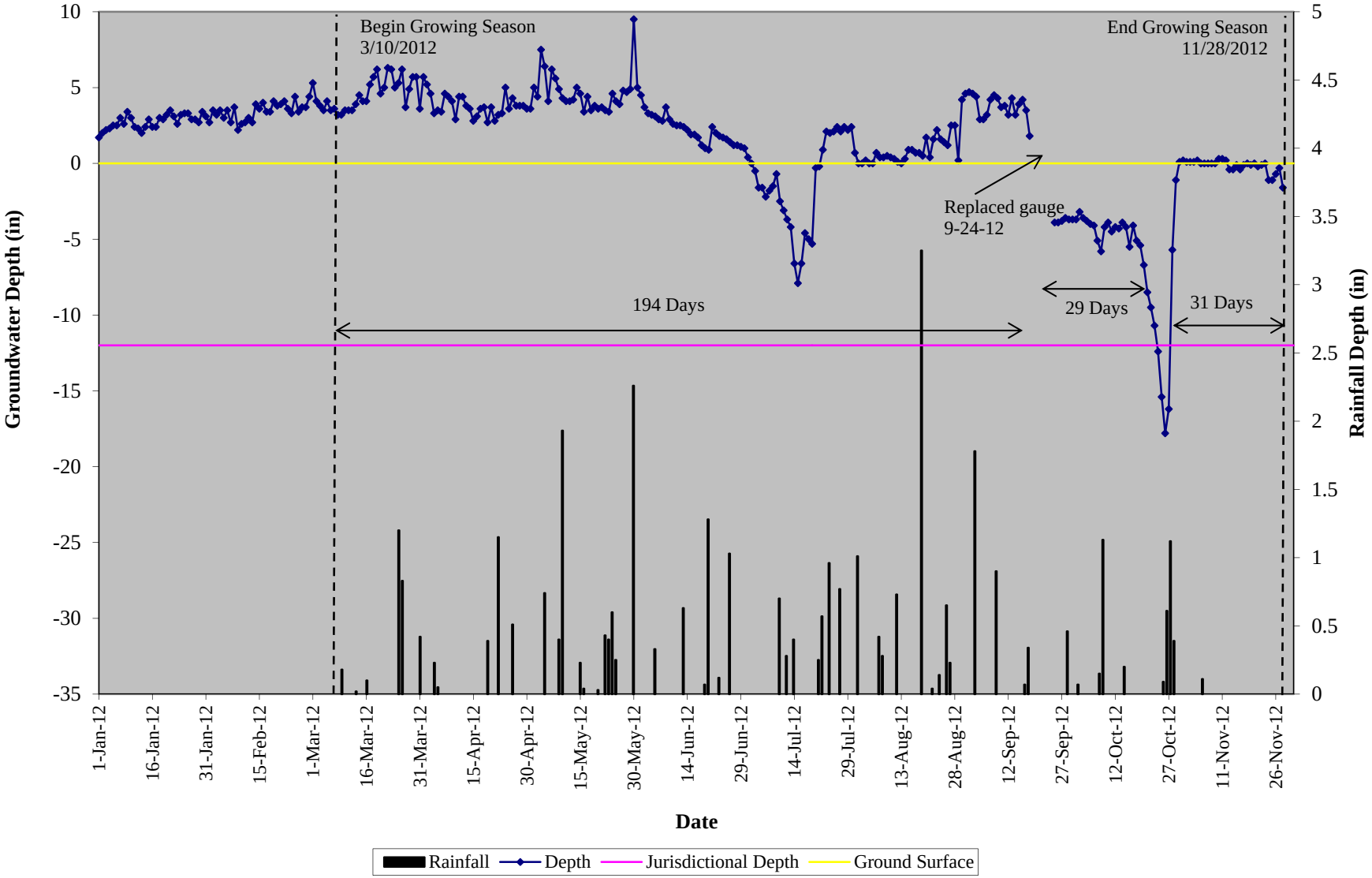
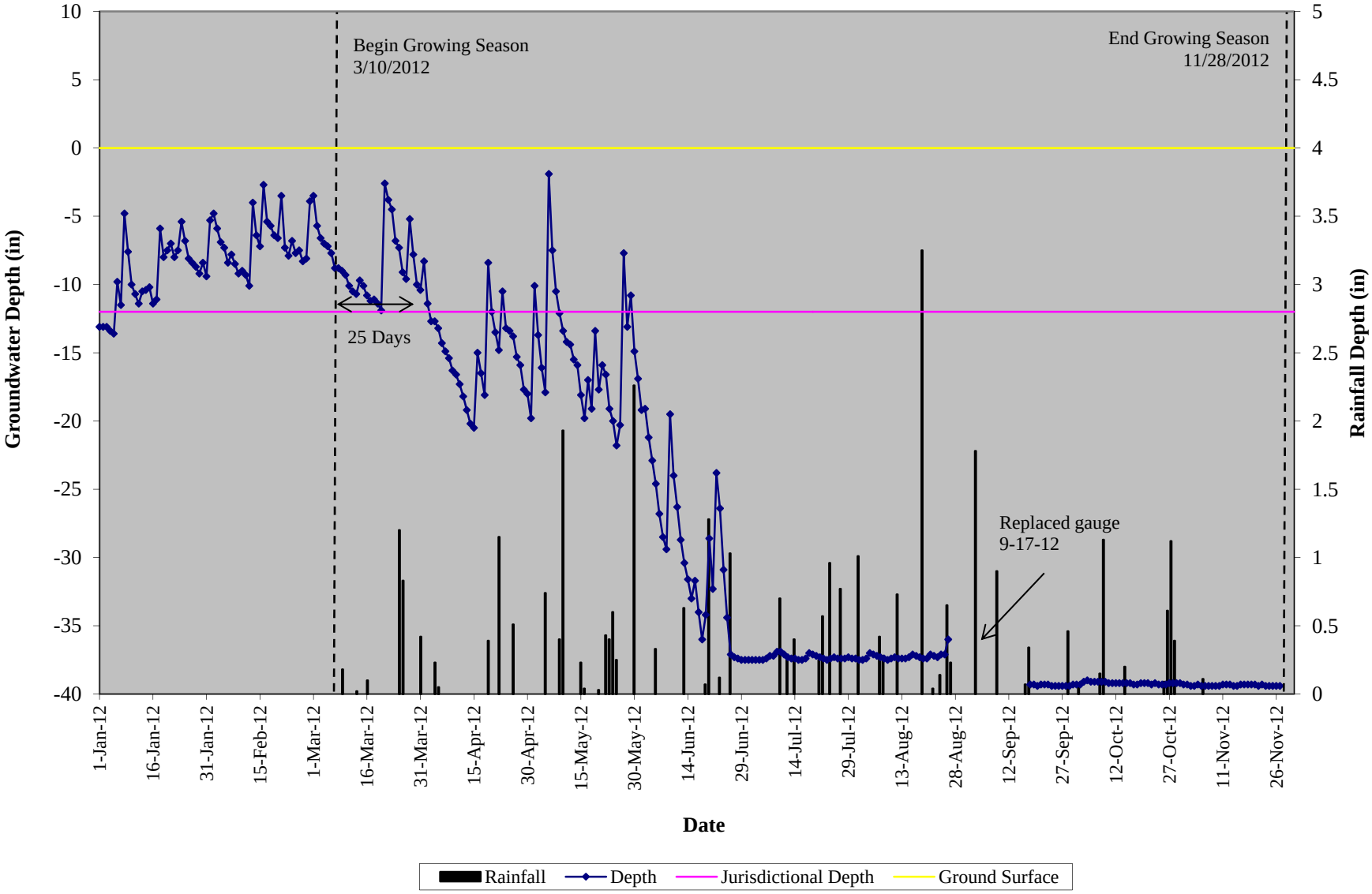


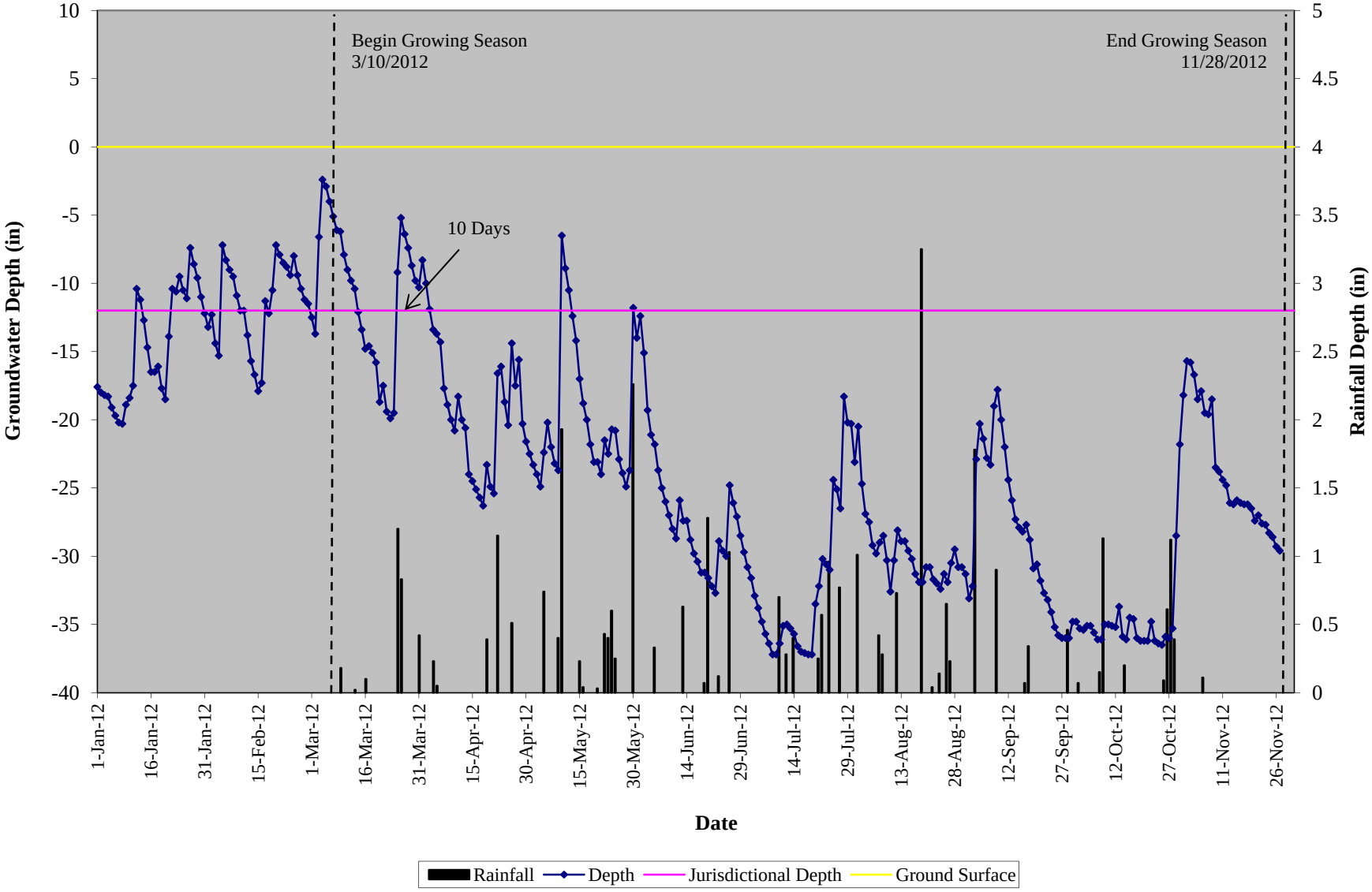
UT Pembroke MY05
Groundwater Monitoring Well #11



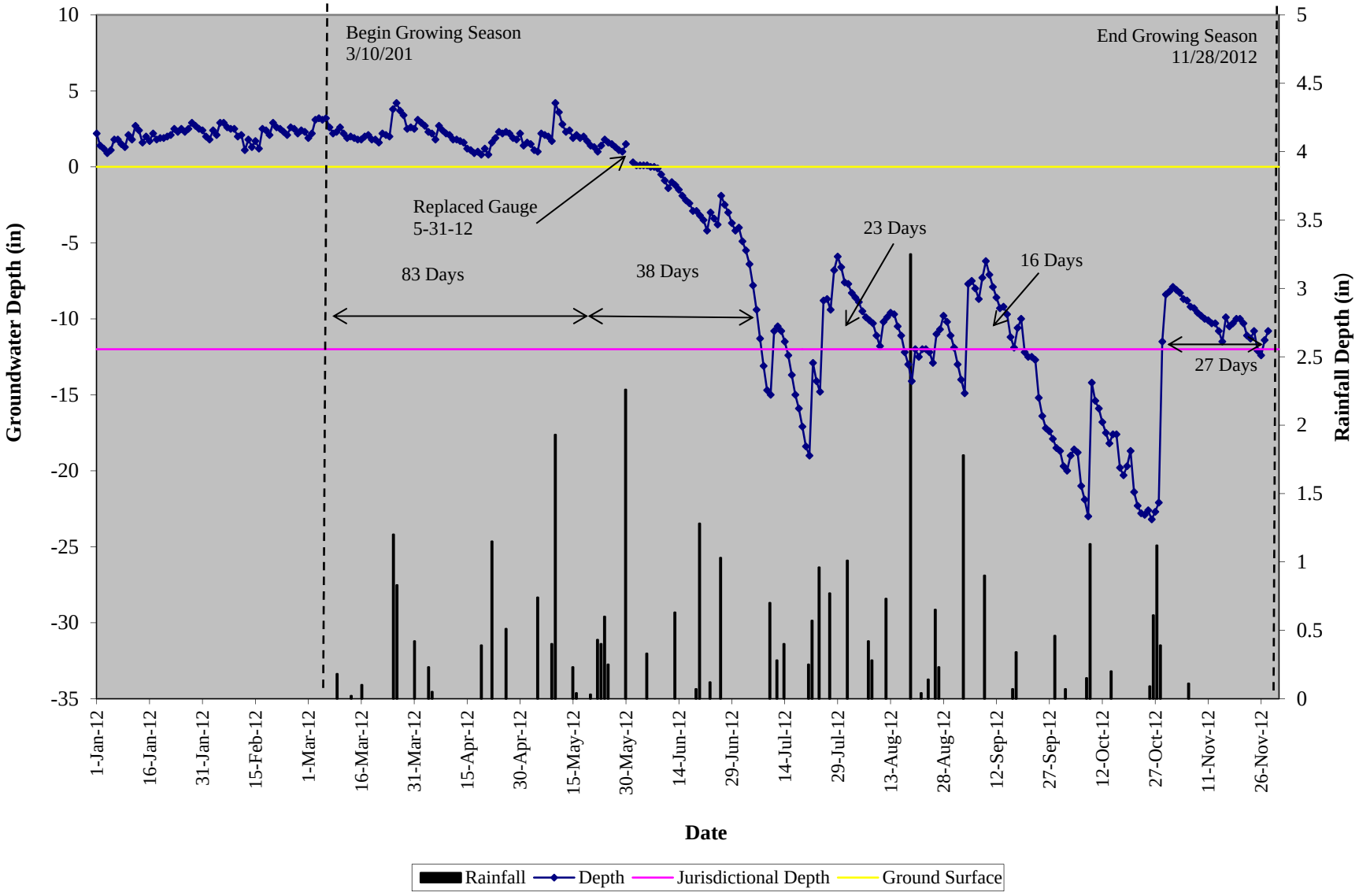
UT Pembroke MY05
Groundwater Monitoring Reference Well #12



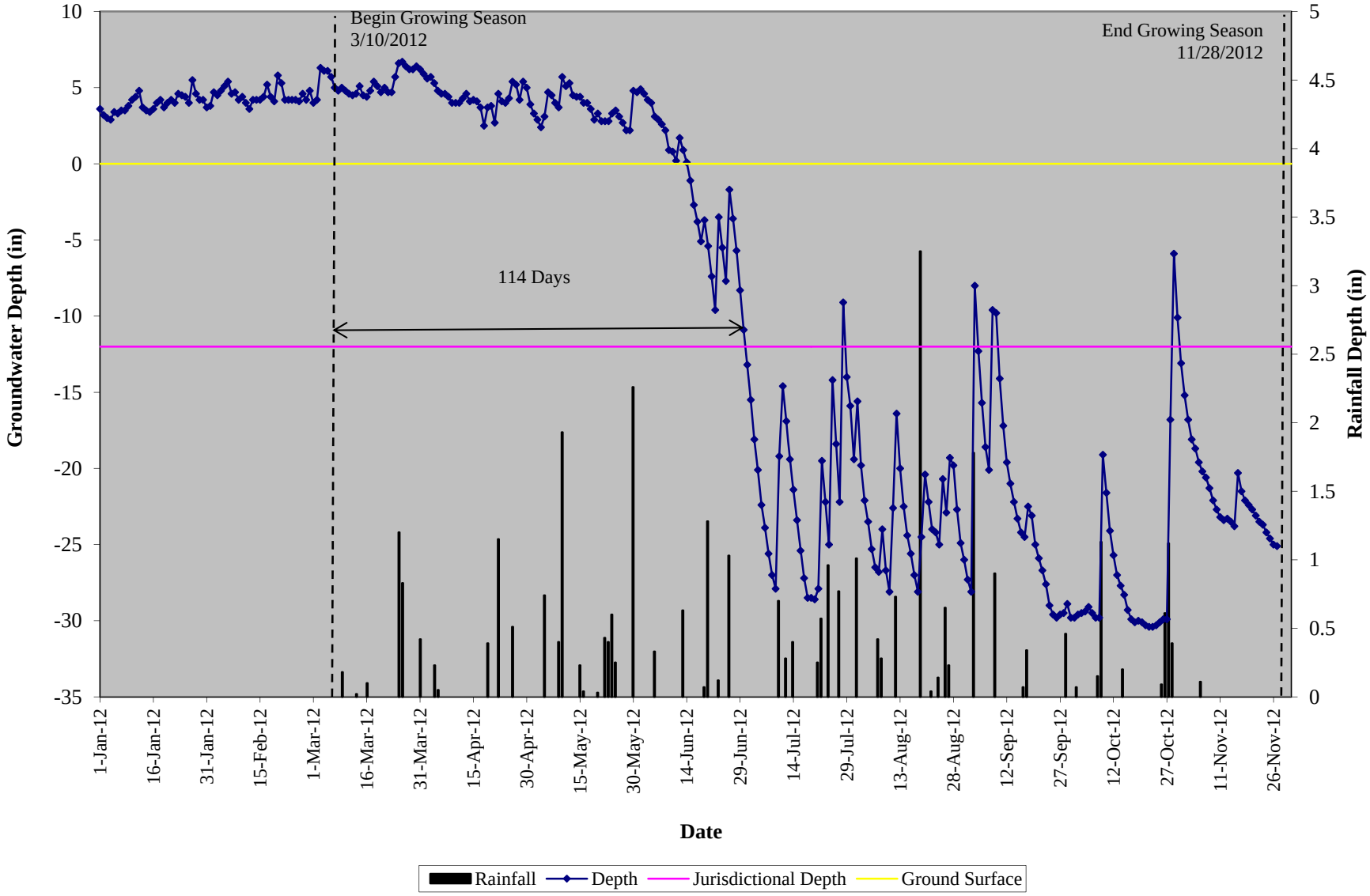
UT Pembroke MY05
Groundwater Monitoring Well #13



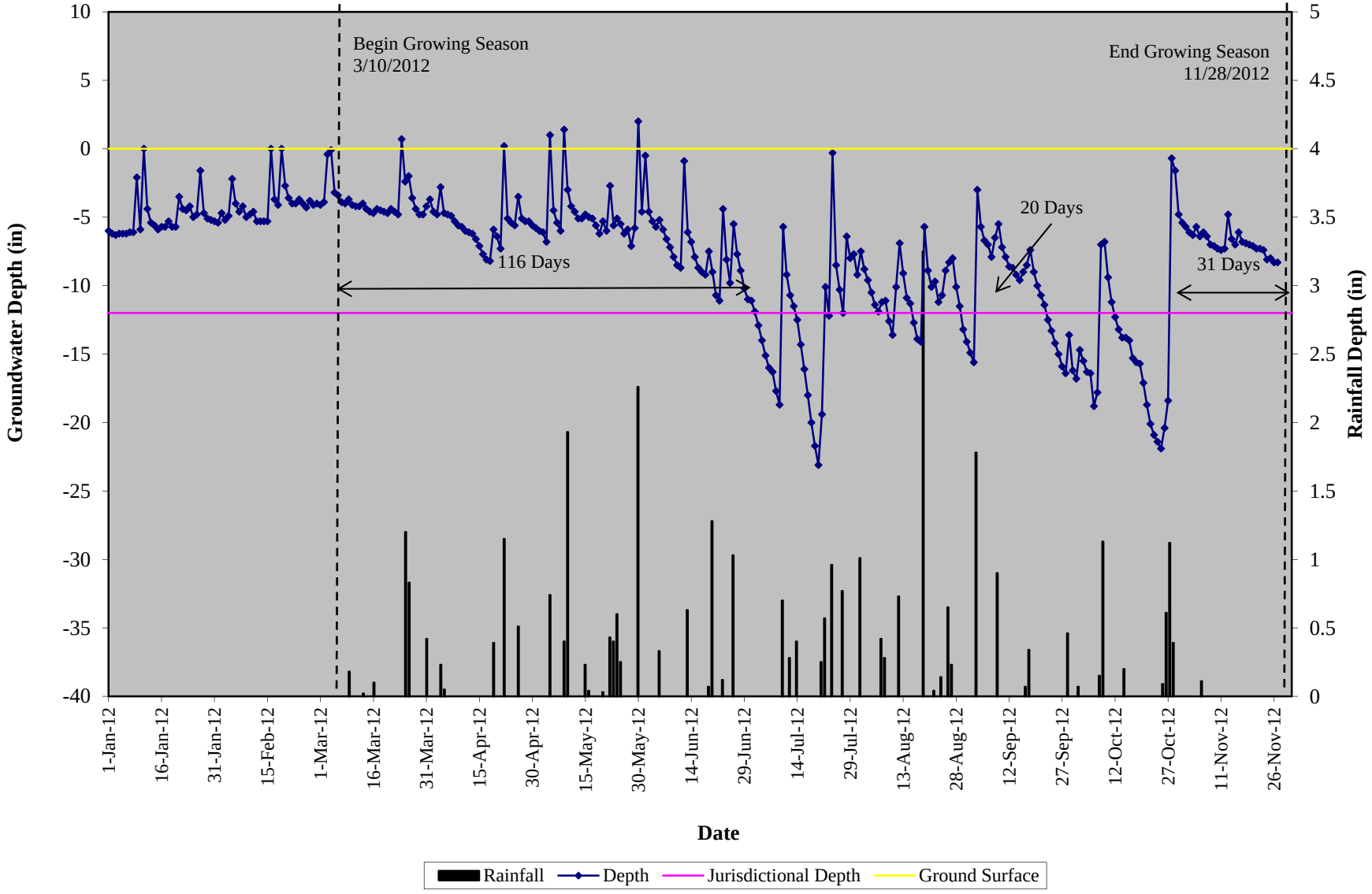
UT Pembroke MY05
Groundwater Monitoring Well #15

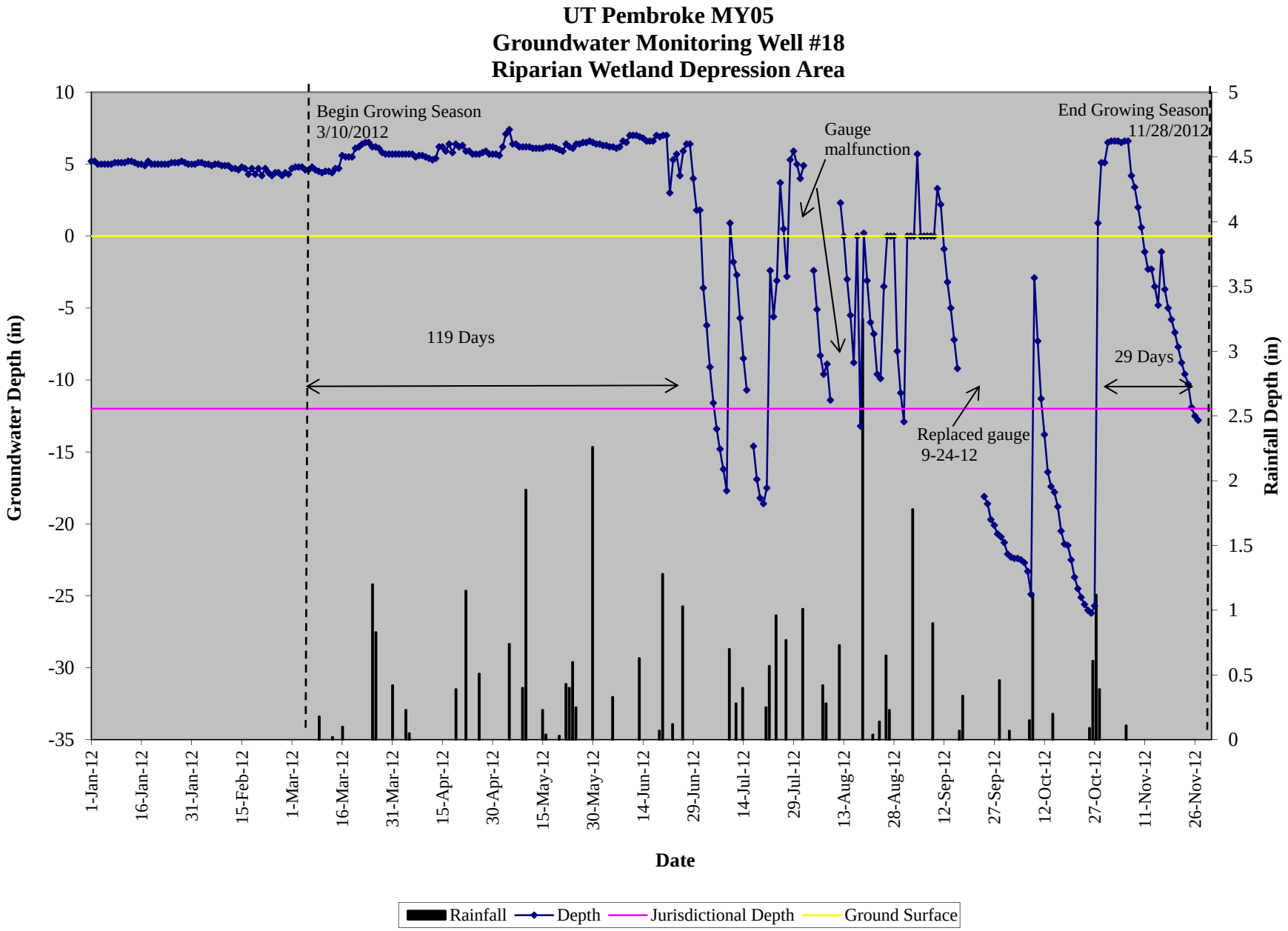


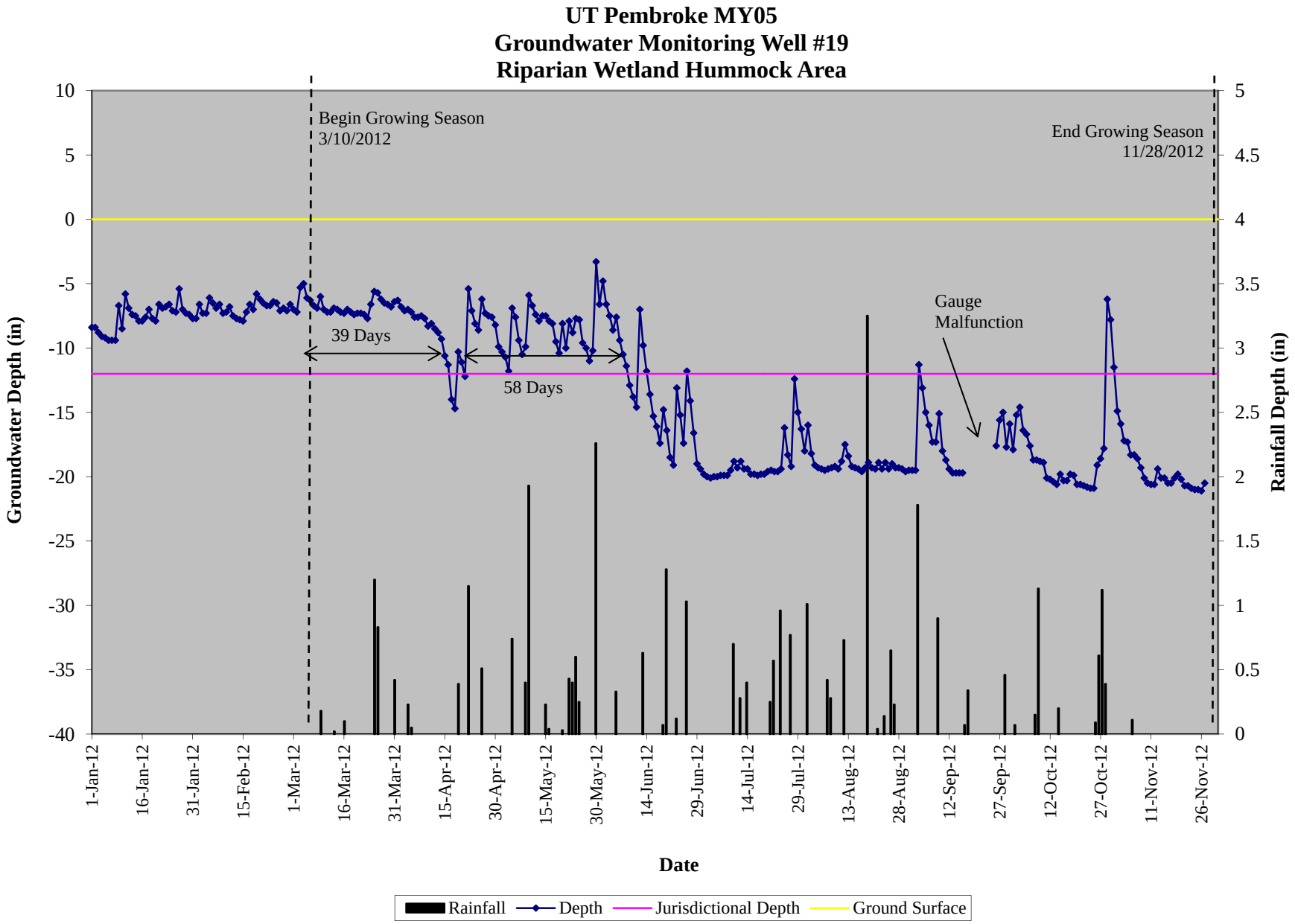
UT Pembroke MY05
Groundwater Monitoring Reference Well #16

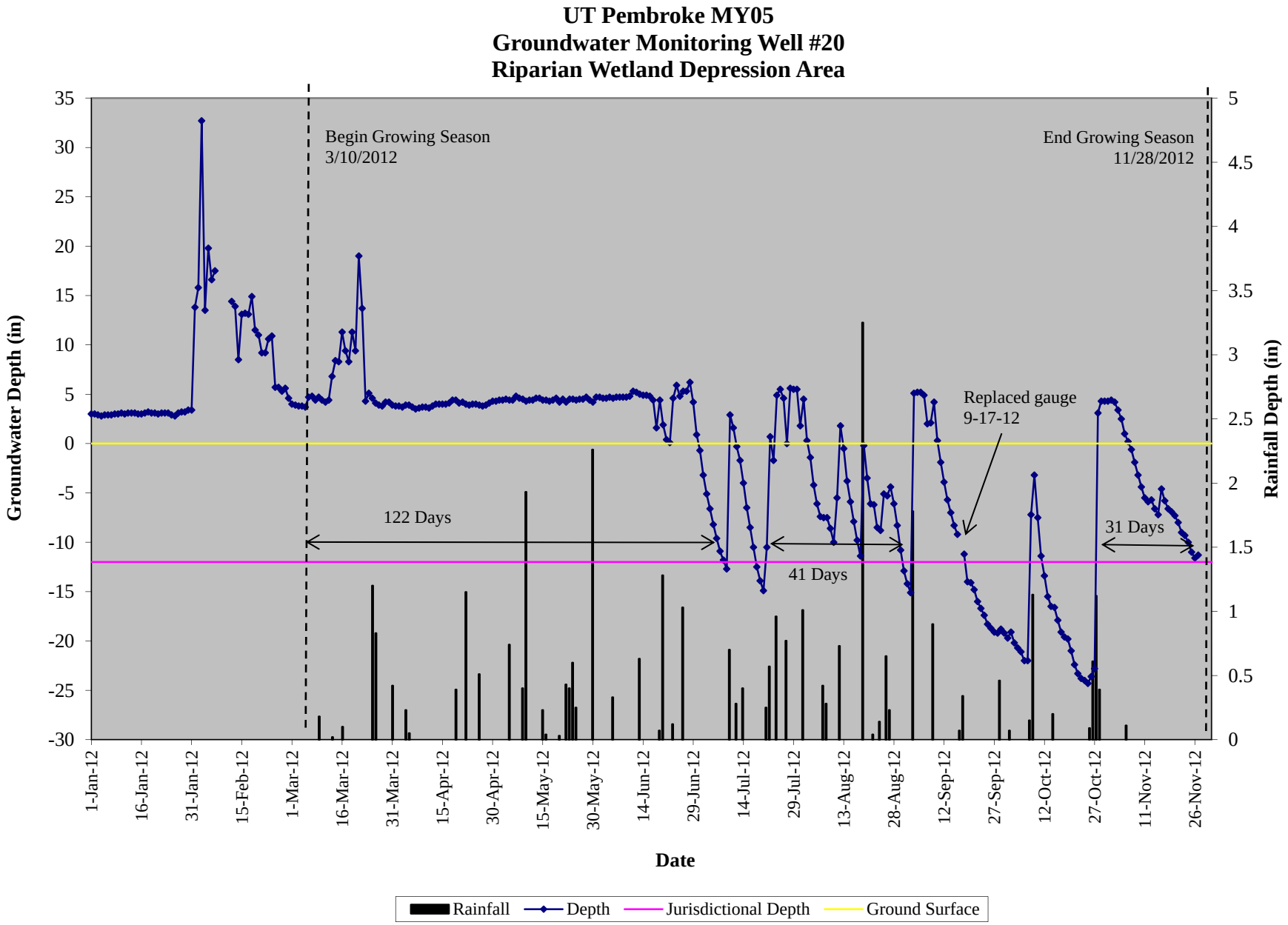


UT Pembroke MY05
Groundwater Monitoring Well #17




UT Pembroke MY05
Groundwater Monitoring Well #18
Riparian Wetland Depression Area
Begin Growing Season
3/10/2012
End Growing Season
11/28/2012
Gauge
malfunction
119 Days
29 Days
Replaced gauge
9-24-12
Groundwater Depth (in)
Rainfall Depth (in)
Date
10
5
0
-5
-10
-15
-20
-25
-30
-35
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Jan-12
16-Jan-12
31-Jan-12
15-Feb-12
1-Mar-12
16-Mar-12
31-Mar-12
15-Apr-12
30-Apr-12
15-May-12
30-May-12
14-Jun-12
29-Jun-12
14-Jul-12
29-Jul-12
13-Aug-12
28-Aug-12
12-Sep-12
27-Sep-12
12-Oct-12
27-Oct-12
11-Nov-12
26-Nov-12
Rainfall
Depth
Jurisdictional Depth
Ground Surface


UT Pembroke MY05
Groundwater Monitoring Well #19
Riparian Wetland Hummock Area
Begin Growing Season
3/10/2012
End Growing Season
11/28/2012
39 Days
58 Days
Gauge
Malfunction
Groundwater Depth (in)
Rainfall Depth (in)
Date
Rainfall
Depth
Jurisdictional Depth
Ground Surface


UT Pembroke MY05
Groundwater Monitoring Well #20
Riparian Wetland Depression Area
Begin Growing Season
3/10/2012
End Growing Season
11/28/2012
Replaced gauge
9-17-12
122 Days
41 Days
31 Days
Groundwater Depth (in)
Rainfall Depth (in)
Date
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Jan-12
16-Jan-12
31-Jan-12
15-Feb-12
1-Mar-12
16-Mar-12
31-Mar-12
15-Apr-12
30-Apr-12
15-May-12
30-May-12
14-Jun-12
29-Jun-12
14-Jul-12
29-Jul-12
13-Aug-12
28-Aug-12
12-Sep-12
27-Sep-12
12-Oct-12
27-Oct-12
11-Nov-12
26-Nov-12
Rainfall
Depth
Jurisdictional Depth
Ground Surface

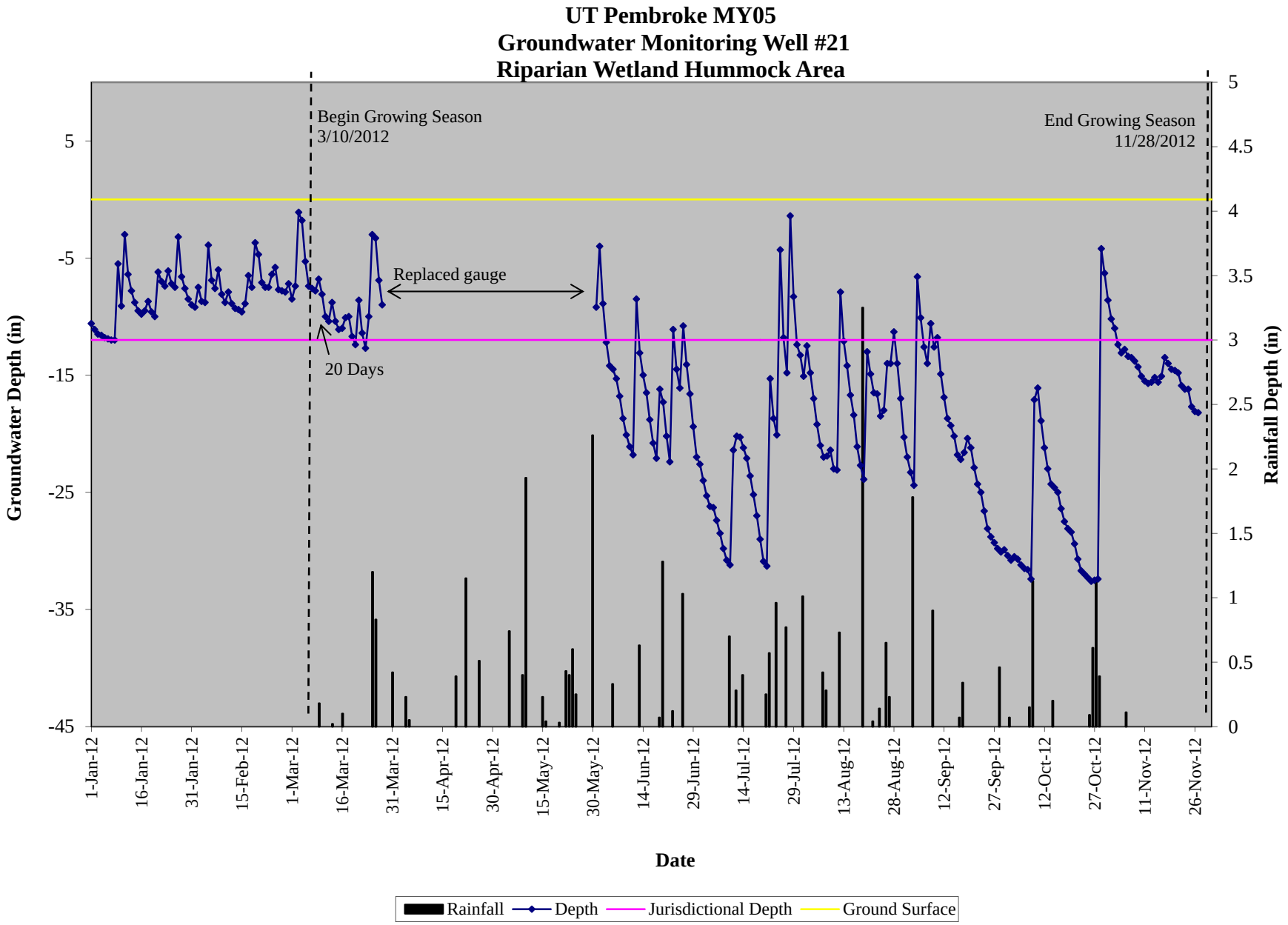

UT Pembroke MY05
Groundwater Monitoring Well #21
Riparian Wetland Hummock Area
Begin Growing Season
3/10/2012
End Growing Season
11/28/2012
Replaced gauge
20 Days
Groundwater Depth (in)
Rainfall Depth (in)
5
-5
-15
-25
-35
-45
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Jan-12
16-Jan-12
31-Jan-12
15-Feb-12
1-Mar-12
16-Mar-12
31-Mar-12
15-Apr-12
30-Apr-12
15-May-12
30-May-12
14-Jun-12
29-Jun-12
14-Jul-12
29-Jul-12
13-Aug-12
28-Aug-12
12-Sep-12
27-Sep-12
12-Oct-12
27-Oct-12
11-Nov-12
26-Nov-12
Date
Rainfall
Depth
Jurisdictional Depth
Ground Surface

Table 9. Wetland Hydrology Criteria Attainment Table
Project Number and Name: 283 - UT Pembroke

Gauge	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2008)	**Year 2 (2009)**	**Year 3 (2010)**	**Year 4 (2011)**	**Year 5 (2012)**
Well 2	No/0 (0%)	No/4 (1.5%)	No/4 (1.5%)	No/4 (1.5%)	No/0 (0%)
Well 3	No/0 (0%)	No/4 (1.5%)	No/5 (1.9%)	Yes/13 (5.0%)	No/3 (1%)
Well 4	No/0 (0%)	No/4 (1.5%)	No/6 (2.3%)	No/10 (3.8%)	Yes/141 (53%)
Well 5	No/11 (4.2%)	Yes/49 (18.6%)	Yes/54 (20.5%)	Yes/23 (8.7%)	No/10 (4%)
Well 6	No/12 (4.6%)	Yes/46 (17.5%)	Yes/50 (19.0%)	Yes/17 (6.4%)	No/10 (4%)
Well 7	Yes/87 (33.1%)	Yes/108 (41.1%)	Yes/104 (39.5%)	Yes/95 (36.0%)	Yes/102 (39%)
Well 8	No/11 (4.8%)	Yes/45 (17.1%)	Yes/42 (16.0%)	Yes/47 (17.8%)	Yes/13 (5%)
Well 9	Yes/51 (19.4%)	Yes/49 (18.6%)	Yes/57 (21.7%)	Yes/94 (35.6%)	Yes/34 (13%)
Well 10	Yes/207 (78.7%)	Yes/110 (41.8%)	Yes/103 (39.2%)	Yes/101 (38.3%)	Yes/114 (43%)
Well 11	Yes/107 (40.7%)	Yes/263 (100%)	Yes/138 (52.5%)	Yes/147 (55.7%)	Yes/194 (74%)
Well 12 *Reference*	Yes/77 (29.3%)	Yes/53 (20.2%)	Yes/55 (20.9%)	Yes/59 (22.3%)	Yes/25 (10%)
Well 13	No/10 (3.8%)	Yes/31 (11.8%)	Yes/39 (14.8%)	Yes/37 (14.0%)	No/10 (4%)
Well 15	Yes/174 (66.2%)	Yes/107 (40.7%)	Yes/133 (50.6%)	Yes/146 (55.3%)	Yes/83 (31%)
Well 16 *Reference*	Yes/112 (43%)	Yes/87 (33.1%)	Yes/120 (45.6%)	Yes/101 (38.3%)	Yes/114 (43%)
Well 17	N/A	N/A	Yes/140 (53.2%)	Yes/101 (38.3%)	Yes/116 (44%)
Well 18 Located in the wetland depression area	N/A	N/A	Yes/63 (24.0%)	Yes/59 (22.3%)	Yes/119 (45%)
Well 19 Located in the wetland hummock area	N/A	N/A	Yes/61 (23.2%)	Yes/99 (37.5%)	Yes/58 (22%)
Well 20 Located in the wetland depression area	N/A	N/A	Yes/63 (24.0%)	Yes/99 (37.5%)	Yes/122 (46%)
Well 21 Located in the wetland hummock area	N/A	N/A	Yes/25 (9.5%)	Yes/99 (37.5%)	Yes/20 (8%)